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WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

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LET'S ADJUST IMPORTS WITH DEMAND

IT IS A DISCONCERTING coincidence that the gains in crude oil stocks in the U. S. thus far this year have almost exactly amounted to the increase in imports of foreign oil into the country. Imports have been running at the rate of 112,000 barrels per day ahead of last year for the first six months of 1949, or an average of 415,000 barrels per day.

WORLD OIL has always taken the position that, while realizing the oil industry is international in scope, it is to the best national interest of the U. S. that her domestic oil industry be maintained in sound shape against any eventuality. We have never been of the belief that imports of foreign oil should be eliminated by edict or by taxes, but we do think that a sensible balance should be maintained, and that imports of oil, or any product for that matter, should not be permitted to destroy or seriously weaken an important domestic industry. In this thinking we believe that we are in accord with the thinking of most governments.

• • •

WE HAVE THOUGHT, too, that if an industry can keep its own house clean it is better for the industry to do it than to be forced to do so by legislation, because there is never any way of knowing how far a law may go or just how it may be made to operate.

At the present time we are thinking of the 900,000 barrels of domestic crude oil per day which have been cut back since the first of the year. That the cutbacks totaling this amount throughout the nation have played havoc with the tax income of some states is beside the point, although you cannot tell *that* to the state governments involved. That the cutbacks have weakened one of the most important industries in the nation seems to us the important thing.

Very probably there should be some sort of relation between U. S. crude demand and imports of such oil. It should not be too difficult to determine what an equitable relationship should be. A bill has been introduced in the Senate which seeks to set up a relationship between the two.

However, when it comes to dividing up the oil to be imported into the U. S., a number of practical questions impose themselves. How much of the quota shall come from South America? How much from the Middle East? And in a time not so far in the future, how much from Canada? And how shall the division be made between importing companies?

We have been greatly disappointed that the reductions in crude oil imports have not been put into effect in a more substantial manner. Because we believe it to be to the best interests of all concerned, domestic producers, foreign producers, and the public too, that a better balance be maintained. It is true that reductions have been made, but the cuts have been made from the high point during the latter part of 1948 and not from the average for the period under consideration—the first six months of 1949 as compared with the first six months of 1948.

Further, implied pledges to the Texas Railroad Commission have not been fulfilled.

The commission, and others present at the hearing in Houston, April 19, at which information on prospective crude imports was given, were under the impression that June imports would be around 326,000 barrels per day, whereas they will run (it appeared as the month of June closed) in excess of 400,000 barrels per day.

• • •

WE REALIZE that it is an extremely difficult thing to adjust the imports fairly. One company can upset the apple cart, and if the companies get together and allocate the imports among themselves and cut to a commonly predetermined figure, they face anti-trust action.

Then, in all fairness, it should be remembered that the companies operating abroad have invested their money—American dollars—and that these investments, too, were most important to this country in winning the war. We wanted the crude then—we needed it badly—but we wanted domestic production then, also, and needed it just as badly. We know, too, that there are some very sound political and economic reasons why these companies should produce their oil as rapidly as feasible from their properties abroad.

But it is equally unfeasible for them to run the risk of damaging their domestic properties and relations by failure to act realistically under the conditions.

Ray L. Dudley

REPORT FROM
THE OBSERVATORY

Economic Trends More Favorable

By **RAY L. DUDLEY**, Publisher, and **WARREN L. BAKER**, Editor

ECONOMIC TRENDS in the oil industry during June were the most favorable of the year. Encouraging developments resulted in lowering of a part of the storm signals which have been flying over the industry for months, but it appeared that the industry was not entirely out of danger yet and some warning flags still were aloft the end of June.

• • •

HIGHLY ENCOURAGING was the stoppage of additions to crude oil stocks during June, and prospects that sizeable drafts may occur on crude stocks in July and August. Consequently, firmer crude prices appear likely, with postings for light crudes probably now safe for the summer, but additional adjustments in heavy crudes prices a possibility. Meanwhile, large consumption of gasoline was reducing these stocks at satisfactory rates, and there were indications that fuel oil demand would be greater during the coming winter than anticipated heretofore.

Drafts on crude stocks are expected to be of sizeable proportions in July, since lower production allowables have been set in Texas, Louisiana and Arkansas for the month. This would constitute a marked and highly favorable change, crude stocks having risen steadily for a year until the first of June. Latest available figures show U. S. crude in storage totaled just under 275 million barrels on June 18, a decline of 234,000 barrels since May 28 despite a sizeable gain in the latest week which largely offset a sharp decrease during the preceding week.

It is indicated that U. S. production in July will average around 4,800,000 barrels daily as compared with 4,930,000 barrels in June. Since June crude producing rates were closely in balance with requirements, reduced production in July should cause drafts on crude stocks. Predictions as to the amount of crude which likely will be taken from storage in July range from 4 to 10 million barrels.

Unless the Texas Railroad Commission issues a revised order upping the state's allowable in August (the commission has issued a two-month order for July and August cutting allowables by 125,000 barrels daily) another 6 to 10 million barrels likely will be taken from storage during August.

Recent developments in the crude market reflect an increased stability. Although some further reductions in prices of heavy crudes took place during the first half of June, the revisions were far less numerous and widespread than previously and no changes were made in the latter part of the month. Moreover, Pennsylvania Grade crude prices were advanced 13 to 16 cents per barrel after having experienced six successive reductions since last December. Meanwhile, increases ranging up to 28 cents per barrel were posted on California lighter crudes although reductions up to 22 cents per barrel were made at the same time in heavy grade crudes.

Light crude oil shortages are to be more acute under indicated producing rates and stock trends. A shortage of light crudes and an excess of heavy grades have existed for some time, as we have pointed out in past months. The additional cuts in production allowables scheduled for July will further reduce the amount of light crude as well as heavy crude available, reductions generally having been applied without regard to type of oil. Much of the anticipated drafts on crude stocks undoubtedly will involve light grades as refiners attempt to make up for shortages in this type of oil, hence any sizeable reduction of crude oil inventories might actually place the industry in a squeeze for high-gravity crudes. This is more than a mere possibility.

Gasoline stock drafts continue to take place in such volume that earlier worries of an over-supply are disappearing rapidly.

Motor fuel inventories have declined steadily and sharply since March 26. On June 18 they amounted to 116½ million barrels, which was 11½ million barrels less than in late March. Four million barrels of this decrease occurred in the last three weeks. Consequently, gasoline stocks now are only 12 million barrels greater than at the corresponding period in 1948, whereas they were 15 million barrels larger than in 1948 on March 26.

A continuation of this withdrawal rate would bring gasoline inventories down to 75 or 80 million barrels on October 1, the end of the big consuming season. This would be well under the 90½ million barrels held in storage on October 1 last year, and would be beneath the figure of 85 million barrels generally accepted as a desirable level for that time of the year. Therefore, it appears that some enlargement of the motor fuel production rate resulting from any increase in refinery operations could take place without causing gasoline supplies to become a problem.

Higher demand is a definite prospect for the remainder of the year, with particularly significant gains indicated for the fourth quarter. This means larger crude runs to stills are due, which in turn will require increased crude production.

Meanwhile, prospects for distillate fuel oil sales are showing improvement. Shipments of new oil burners are substantially exceeding those of a year ago by a growing volume. Oil burner shipments in May this year were about 45 percent greater than in

But Storm Warnings Still Aloft

WORLD OIL'S summary of the oil situation at the close of June

the same month of 1948; April shipments were 37 percent higher than in April, 1948.

Consequently, sales of heating oils may prove larger than previously anticipated, perhaps as much as 8 percent higher this winter than last winter. Diesel oil consumption may show an even greater gain.

• • •

LESS FAVORABLE developments, causing partial discount of encouraging ones, center chiefly around the fuel oil situation. The growth in distillate and residual fuel oil stocks and their high level for this season of the year may cause a serious oversupply by next winter. Three reasons underlie apprehension on this score: (1) the continued importation of foreign-produced crude at higher rates than in the corresponding months of 1948, much of which yields large quantities of unneeded fuel oils; (2) improper application of restrictions on U. S. production which has resulted in an over-supply of fuel oil-bearing crudes and a shortage of needed gasoline-yielding crudes; and (3) prospective increased refinery runs because of anticipated higher demand, which would enlarge the production of fuel oils along with greater output of gasoline.

While everyone has been greatly encouraged by the beginning of drafts on crude stocks, some still think the crude price situation remains in delicate balance. The excessive supply of fuel oil could overload some companies to the extent that distress selling might result if these stocks continue growing. Such unloading could affect the industry's whole price structure.

In view of the shortage of light crudes, any sizeable reduction in crude stocks might boomerang by causing refiners to depend to a larger extent on heavy crudes against their wishes. Any such development would only add additional quantities of fuel oil to the already excessive volumes on hand. Thus, while the industry's position as a whole may continue improving, the fuel oil situation might become a most seriously weakening influence.

This situation is aggravated by the improper handling of reductions in domestic producing rates. All cuts on Texas production, which in July will account for 700,000 barrels of the nearly 900,000-barrel per day decline in U. S. producing rates since last December, again have been imposed on an "across-the-board" basis without any regard to the market demand for different grades of crude.

Oil men are in unanimous agreement that a 100,000-barrel crude allowable reduction in the right spots would have been far more beneficial than some of the 200,000-barrel cuts applied on an across-the-board basis.

Enlarged imports of foreign crude undoubtedly are another very disturbing factor. Since most of the oil imported is of low gravity, it has added substantially to the oversupply of fuel oil-bearing crudes.

Although importers two months ago informed the Texas Railroad Commission that imports would be reduced to 325,000 barrels daily in June, preliminary figures indicated crude imports in June will average 415,000 barrels daily. This rate would be approximately the same as in May and April, but in contrast with a low of 357,000 barrels per day in March of this year. Available data also indicate crude imports during the first six months of 1949 will average around 415,000 barrels daily. This would represent an increase of 112,000 barrels per day or 37 percent above the quantities imported during the first half of 1948, or also exactly the same amount of gain shown by U. S. crude stocks since the first of the year.

Although the outlook now is for the sale of more distillate fuel oil than heretofore anticipated, stocks of this product must still be regarded as excessive. Inventories of distillate fuel oils east of California now total 50 million barrels, an increase of 19 million barrels or 60 percent over a year ago. Therefore, refiners must continue to hold yields of these products to a minimum, particularly if crude runs to stills are increased.

In view of the surplus of heavy oils, the installation of additional facilities for handling this type of crude would seem imperative.

• • •

IN SUMMARY, recent industry trends have been on the plus side. Stoppage of additions to crude stocks and reductions in gasoline inventories, offsetting the continued over-supply of fuel oil.

In prospect are higher petroleum product consuming rates. This outlook, when coupled with present low production allowables presages reductions in crude stocks, higher producing rates later in the year and decreases in gasoline stocks to satisfactory levels. Consequently, stronger price structures are indicated. In view of the improvement in the crude supply relationship with demand, we think only a not-now-indicated weakening of the gasoline market would cause a light crude oil price cut this summer, although additional adjustments may occur in heavy crudes in some areas, due to local conditions.

However, the situation must be viewed with some caution because of the fuel oil situation—which could become acute suddenly if refiners manufacture too much of this product.

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The Changing Panorama

Conditions Good for Oil Industry Workers

INDUSTRIAL STABILITY in terms of labor satisfaction and welfare is higher in the petroleum industry than in nearly any other industry in the U. S., according to an analysis made by J. B. Plumb, marketing coordinator of Sun Oil Company in an address before the Cleveland Petroleum Club. From 1946 to 1948, inclusive, American industry experienced 12,097 strikes, according to the Bureau of Labor Statistics. On this basis there should have been 121 strikes in the oil refineries (where most strikes in the oil industry occur), but there were only 26.

This reflects the fact that "the oil industry is a good place in which to work," said Plumb. "That includes three elements: high wages, stability of employment and good employe benefits. On all three the oil industry's score is especially high."

In the years 1946, 1947 and 1948 the average weekly wages of all oil refinery workers ranged from 26 to 35 percent above the average of all manufacturing industry; and the wages of all oil and gas production employes ranged from 20 percent to 25 percent above. Bureau of Labor Statistics show that for January, 1949, oil refinery employes drew the highest average weekly wage of all classes covered by the bureau's report.

Labor turnover is low in the oil industry, Plumb pointed out. From 1946 to 1948 separations from employment in all manufacturing industry ran at five times the rate reported for petroleum refining.

Plumb quoted a National Industrial Conference Board survey to show that oil companies are in the forefront in providing for employes' inexpensive life insurance, sickness and accident benefits, free physical examinations, medical facilities, paid sick leaves, and hospitalization. "In addition," says Plumb, "oil companies are far above the average in assisting employes in social and recreational activities, in providing pension plans, stock purchase plans, adult education, and liberal holiday and vacation allowances, and in the preparation of employe publications and other communications to employes."

The petroleum industry's record on wages, stability of work and employe benefits is grounded in certain economic circumstances which are outstanding. The first is the extremely high investment per employe, a situation which results in raising the level of skills required in oil industry jobs. The second is "the large amount of horsepower provided per employe in the petroleum industry which makes the total direct wage cost lower in relationship to total costs than in industries which depend to a large extent on human muscle-power." The third is the steady demand for petroleum products without wide seasonal swings. A fourth lies in the steady expansion of the oil industry, thereby affording the creation of new job opportunities; and a fifth "is the competitive nature of the petroleum industry which has made it prudent for oil company managements to maintain wages and employe benefits on a competitive basis."

Imports Force Review Of Foreign Activity

CLAMOR FOR limiting U. S. oil imports is making it increasingly essential for importing companies to base their foreign operations primarily on foreign markets, as they have generally done heretofore.

In view of recent high imports in the face of sharply reduced domestic production, there is now vigorous insistence by domestic producers that the federal government should limit imports by tariff or quotas. Such restrictions are necessary, it is contended, to make into effective national policy the principle of letting foreign oil supplement but not supplant domestic oil—a principle generally accepted by importing companies as well as domestic producers to assure a healthy and strong domestic industry, capable of meeting national emergencies.

This demand for limiting imports by law is based on the fact of recent high imports and the contention that voluntary action of importing companies is impractical. Cut-backs in imports by one company are too easily offset by increases of other companies, it is stated, and reductions by all American importing companies could be offset by shipments of foreign-owned companies.

This problem is expected to become more acute as development of prolific foreign production proceeds. Within a few years, foreign producing potential will be 1 million barrels a day above foreign consumption, it is claimed.

The U. S. government therefore has before it an important question of policy.

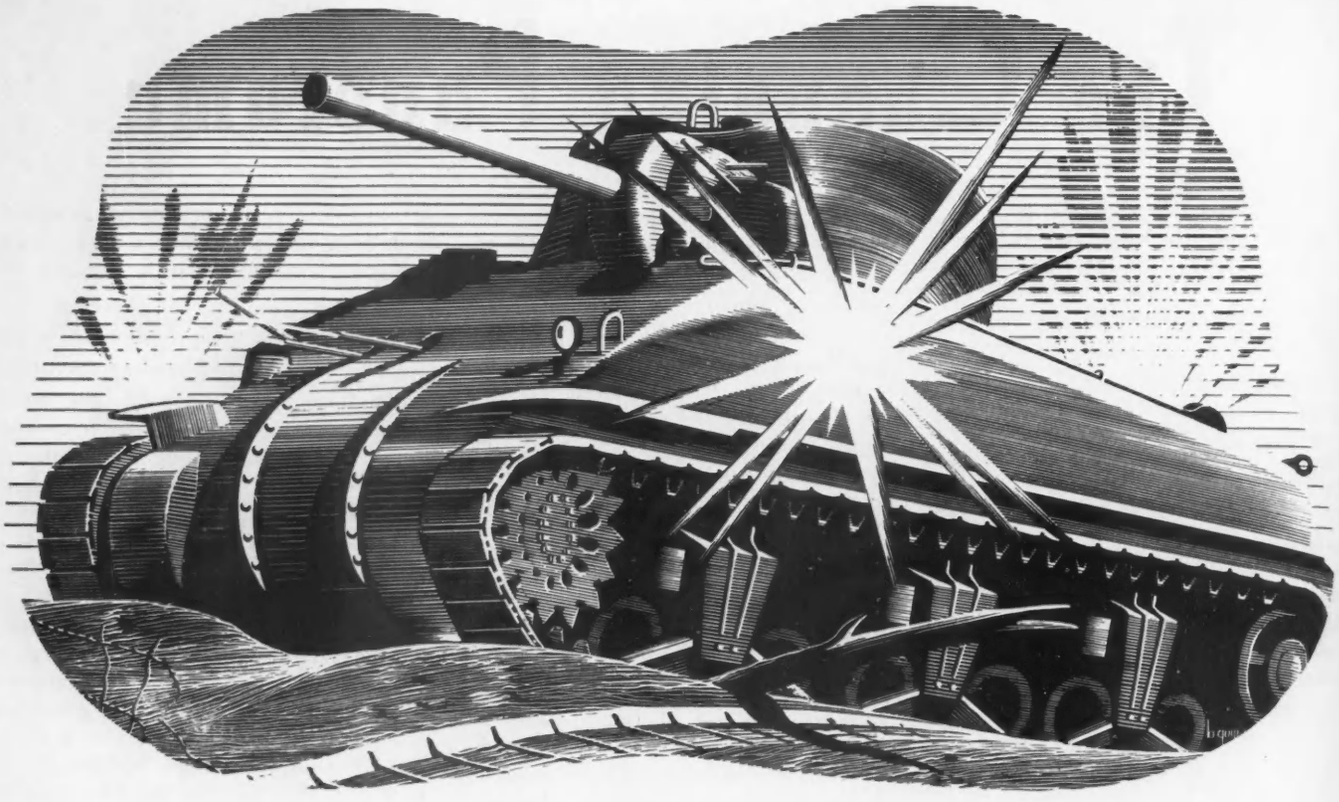
Associations of independent operators are putting increasing pressure upon Congress, demanding limitation of imports, and importing companies themselves deny that they want to supplant domestic oil with foreign oil. In these circumstances it would seem that appropriate government policy and industry action should not be too difficult.

However, the problem is complicated by the ramifications of overall foreign policy and aims. American development of industry in friendly foreign countries is one of the principal aims of present foreign policy. President Truman enunciated the aim of "making the benefits of our scientific advances and industrial progress available for improvement and growth of underdeveloped areas."

Strictly in accord with this aim are the American oil company operations abroad. U. S. oil companies have taken a very prominent part in furthering industrial progress abroad by the application of private capital and technical skills. They also have pursued high ideals and standards in dealing with the people of the countries where they operate, aiding social and economic welfare and training native workers for oil industry jobs, thus promoting good will toward America.

The U. S. government has encouraged oil development in foreign countries in various ways, including the making of reciprocal trade agreements, under which tariff rates on oil imports have been reduced.

In dealing with the import question the U. S. government will have to reconcile its attitude with the general foreign policy and the past policies regarding oil, while giving full consideration to the interests of the domestic industry and the national welfare. Insofar as the government and U. S. companies operating abroad can help to increase foreign consumption, the foreign nations will benefit and there will be less pressure to seek markets for the foreign oil in the U. S. And insofar as U. S. companies henceforth shape their foreign operations increasingly in line with foreign requirements, the need for new government restrictions on imports will be reduced.



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Monthly News Analysis

U. S. HAS RELATIVELY LOW OIL INVENTORY . . . MARKETS STABILIZING
PRODUCTION TO BE CUT FURTHER . . . INDUSTRY TO SPEND $2.1 BILLION

Oil Stocks Called Low on Basis of Days' Supply

Not an over-supply but a relatively low inventory of oil actually exists in the U. S. at the present time, according to analyses presented by the Oil and Gas Division of the Interior Department before recent Congressional committees. One Oil and Gas Division spokesman said that the current "excess oil" situation is primarily one of inadequate movement of refinery stocks into secondary storage.

"Many persons consider supply simply in terms of the number of barrels of above-ground stocks," he said. "In reality, the proper index of supply is the daily consumption rate against existing stocks. If this yardstick is applied the U. S. is at a low point, not a peak, in petroleum supplies."

He testified that the curve of "days' supply of petroleum" has been almost steadily downward for ten years. In 1938 that index stood at 147; in 1940 at 137; in 1942 at 118; in 1946 at 88; and today, despite "shortage" conditions it is only 92.

Two factors are responsible for the present "appearance of abundance" of oil: the warm winter of 1948-1949, and the lack of normal movement of stocks from primary to secondary storage. The past winter averaged 8.2 percent warmer than normal and the greatest deviation to the abnormally warm was in the Atlantic seaboard area where one-fifth of all the nation's home oil-burning units are installed.

Unsettled price structures in both light and heavy oils have slowed normal storage movements of these products. It is the opinion of many industry economists that the latter half of 1949 will see such an adjustment in secondary storage as to strengthen prices and reflect back on both production and refinery runs.

Price Changes Fewer as Markets Gain Stability

Although recent weeks have brought some further reductions in prices of kerosine, fuel oil, and heavy crudes, the revisions were far less numerous and widespread than previously, and increases have been posted in prices of Pennsylvania grade crudes and some lighter crudes in California. The markets have assumed more stability through the sustained curtailment of crude production and refinery runs and the reductions in prices of products and crudes that have been in oversupply.

Several factors offer promise that the markets henceforth will be comparatively firm and that prices may be steadier. Crude production is due to continue under strict curtailment, with allowables closely in line with the market requirements of crude purchasers. Consequently, there should not be further material additions to crude stocks, and refiners should not be forced to produce excessive volumes of fuel oils that cannot be marketed.

Although refinery stocks of kerosine and fuel oils are comparatively high, it is indicated that movements into secondary storage have been sub-normal and will have to be increased. Marketers and consumers have held off on purchases from refiners because it was indicated that fuel oil prices might go lower. However, secondary storage must be built up during the summer and fall to avoid shortages next winter. With prices now more stable, and with some refiners offering to protect customers against any further price declines, the movement into secondary storage now is encouraged. Such movement would tend to strengthen the fuel oil market and improve the crude market.

Among the recent further adjustments of product prices was the June 21 reduction by Standard Oil Company (Indiana) in its "normal" consumer tank wagon prices by ½ cent per gallon on kerosine, range oil, furnace oil, and diesel oil, effective in 11 Midwestern states where the company markets.

Esso Standard Oil Company announced in New York June 17 that it would extend from September 1 to October 1 its price protection to re-sellers of No. 2 fuel oils. If prices should decline within that period, the customers meanwhile making purchases would be given the advantage of such decreases. Some other companies have offered customers similar price protection.

Effective June 16, the Joseph Seep Purchasing Agency of South Penn Oil Company increased Pennsylvania grade crude prices 13 to 16 cents a barrel. Bradford Allegany crude was raised 13 cents to $3.40 per barrel. This action erased the 13 cent reduction of May 11, which was the final of a series of cuts since early December, 1948, when Bradford crude was $5 per barrel. The upturn in prices reflected achievement of balance between supply and demand for this lube-oil crude.

Leonard Pipe Line Company effective June 13 reduced all its postings for Michigan crudes 15 cents per barrel. Simrall Division of Roosevelt Oil & Refining Company had cut its Michigan postings 22 cents on May 16, and two days later Bay Pipe Line Corporation lowered postings the same amount.

A reduction of 13 cents a barrel in Gulf Refining Company crude postings in six South Louisiana fields around New Orleans, effective June 7, was described by the company as an "adjustment," which made these prices the same as those of several other purchasers for comparable crudes.

Ohio Oil Company on June 1 reduced postings for Stephens, Arkansas, crude by 25 cents a barrel, in reflection of the weak demand for heavy oils.

On the West Coast, effective June 1, Standard Oil Company of California lowered heavy fuel oils 15 cents a barrel. It was the third cut since the beginning of the year, the three having totaled 60 cents. At the same time the company posted reductions ranging up to 22 cents in heavy grade crudes and increases up to 28 cents in lighter crudes. Standard's lowest posting, 99 cents a barrel for Gato Ridge 12-gravity crude, is down 95 cents from the peak reached in 1948. Union Oil Company on June 2 revised crude postings, reducing heavy crudes by amounts ranging up to 33 cents and increasing lighter crudes as much as 16 cents. General Petroleum Corporation lowered light and heavy fuel oil prices 10 to 15 cents to meet competition.

Production of Crude Due For Further Curtailment

Further curtailment of crude production in July and no material increase in August is the prospect facing U. S. producers under proration programs for those months. As compared with reported U. S. production of 4,930,750 barrels daily in the week ended June 11, it

is indicated that the national output may average only around 4,800,000 barrels daily for July.

In announcing Texas allowables for July and August, the Texas Railroad Commission said they represented a reduction of 125,000 barrels daily from June 11 allowables and a reduction of 135,000 daily from June 1. This cut in allowables was in line with reductions in crude purchasers' nominations.

In an emergency order effective June 15, Louisiana allowables were cut 10 percent from the 544,885 barrels per day originally authorized for June 1. The order did not apply, however, to stripper wells. The Louisiana Department of Conservation said the lower allowables were necessary because of excessive supplies of crude and lack of storage and markets.

The Arkansas Oil & Gas Commission reduced allowables 15 percent in an emergency order June 6 and has extended the order through July. The reduction was made after Esso Standard Oil Company reduced crude purchases by 15 percent in Louisiana, Arkansas, and Mississippi in early June. The company explained that the action was due to slow movement of distillate fuels from its Baton Rouge refinery and resultant filling of tankage. At the beginning of June, Arkansas was producing about 80,000 barrels daily.

Mississippi crude production also has been reduced in consequence of the cut in purchases by Esso Standard. The state averaged 107,000 barrels daily in May, and output was down to 98,500 daily in the week ended June 11.

The Esso Standard 15 percent reductions in field runs and crude purchases in the three states amounted to a total of about 40,000 barrels daily, and the company curtailed crude runs at the Baton Rouge refinery by about 30,000 barrels daily.

Demand Outlook Points To Higher Operations

Although the total demand for all oils in the first quarter of 1949 was 1.4 percent less than in the initial quarter of 1948, it is still expected that this year as a whole will show a moderate increase over last year's all-time record demand.

Among those who expressed this view were F. W. Abrams, chairman, and Eugene Holman, president, of Standard Oil Company (N. J.), in statements to stockholders June 1. Holman said there had been no marked change in basic and growing demand for heating oil products. Declines of about 6 percent in domestic heating oil sales and 14 percent in kerosine sales in 1949 compared with last year were attributed largely to the past winter's unseasonably warm weather. Gasoline sales have been running 9 percent above last year, and for gasoline and railroad diesel oils, there has been no leveling off in the upward trend in consumption, said Holman, although some leveling off may be expected to occur. Industrial fuel oil sales have stopped increasing, he stated, and have been about 5 percent lower than last year.

While some increase in demand is in prospect for 1949 over 1948, crude production and refinery runs are lower than last year. Holman explained that this is because last year more than 5 percent of the industry's production of crude and finished products went into building up inventories. This year, he said, substantially all the industry's production is expected to reach consumers, with little if any devoted to increasing stocks.

Present rates of supply in the form of domestic production and imports are at least 6 percent below predicted demand in the second half of this year, Holman stated, and therefore some increase in industry operations seems inevitable.

$2.1 Billion to Be Invested By U. S. Oil Industry in 1949

Capital expenditures by the U. S. petroleum industry in 1949, for expansion and modernization, will total about $2,146,206,000, a decrease of 8.9 percent from the peak of $2,355,033,000 reached in 1948, according to an API survey. The 1949 total will be equivalent to $53 for each of the 40 million cars, trucks, and buses in the country. Major part of the capital will come out of oil company earnings and the remainder from loans by banks and insurance companies.

Of the projected 1949 capital expenditures, $1,134,784,000 (52.9 percent) will go into the production division, $524,797,000 (24.4 percent) for refining, $201,019,000 (9.4 percent) for transportation, $232,145,000 (10.8 percent) for marketing, and $53,461,000 (2.5 percent) for other facilities.

The above percentages of the total for production and marketing are slightly higher than in 1948, while those for refining, transportation, and miscellaneous are slightly lower. The total capital expenditures of $2,355,033,000 in 1948 included $1,223,320,000 (51.9 percent) for production, $588,012,000 (25.0 percent) for refining, $264,273,000 (11.2 percent) for transportation, $209,078,000 (8.9 percent) for marketing, and $70,350,000 (3.0 percent) for other facilities.

The scheduled investment for production facilities in 1949 is 7.2 percent less than in 1948, compared with the 8.9 percent decrease for the industry as a whole.

In 1947 the industry invested $1,878,147,000 in new facilities and rehabilitation. For the three years, 1947, 1948, and 1949, the total will amount to $6,379,386,000. Of this, the production division will account for a little more than 50 percent, with investment of $3,255,489,000.

In addition to the total of more than $2.1 billion in direct capital investment in 1949, the nation's oil companies have budgeted $119,119,000 for intangible development. These funds are earmarked to pay for the proving and development of prospective oil fields when such costs are not capitalized and in part for losses sustained when wells fail to produce and are abandoned as dry holes.

Compromise on Tidelands Is Proposed in Congress

Congress may work out a temporary solution of the tidelands dispute by which state control of offshore oil development will be assured pending the result of the federal government's suits against Texas and Louisiana. The compromise proposal emerged from a Washington "peace conference" sponsored by House Speaker Rayburn and attended by representatives of government agencies and by delegates from the states involved.

Chief points in a plan proposed by representatives of several states are:

1. The states would concede "paramount rights" of the federal government in the submerged areas from low tide out. But the term "paramount rights" would remain undefined and the issue of ownership of the submerged areas would not be raised.

2. Present state claims and laws, proration policies, taxes, etc., would apply to the submerged areas for those distances offshore that are now claimed by the states. This would be 10½ miles for Texas, and three miles for the other states.

3. In the areas so conceded to the states, the states themselves would derive 62½ percent of all royalties on oil development, and the federal government would receive 37½ percent. Beyond the states' areas, the percentages would be reversed—the federal government receiving 62½ percent and the states 37½ royalty.

4. Once passed by Congress, this compromise would have to be approved by the state legislatures of all states involved in a three-year period.

The Department of Justice is working on a bill, which would be introduced only after approval by Atorney General Tom Clark and Secretary of Interior Julius A. Krug, embodying some of the above ideas but differing with some. It would not require ratification by state legislatures and would not give to the states any share in oil revenue out beyond the traditional borders. Within those borders it would recognize validity of present oil and gas leases, and

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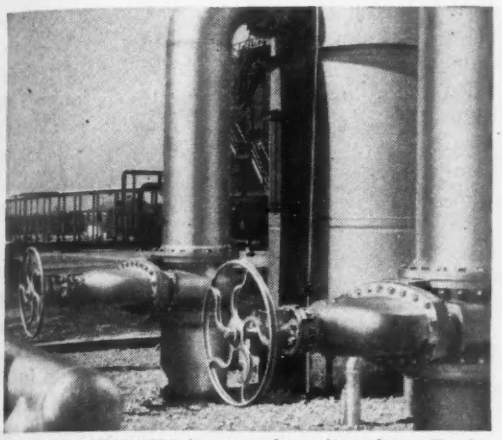

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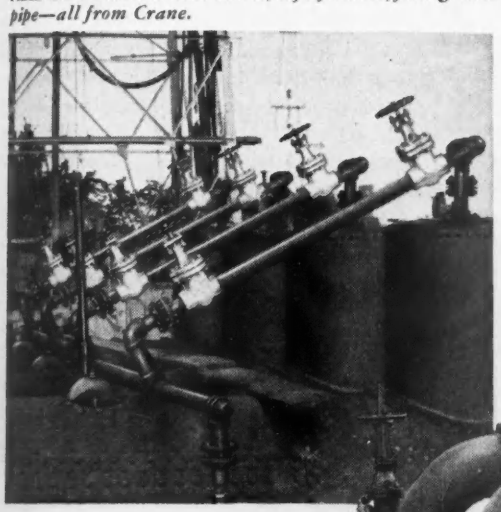

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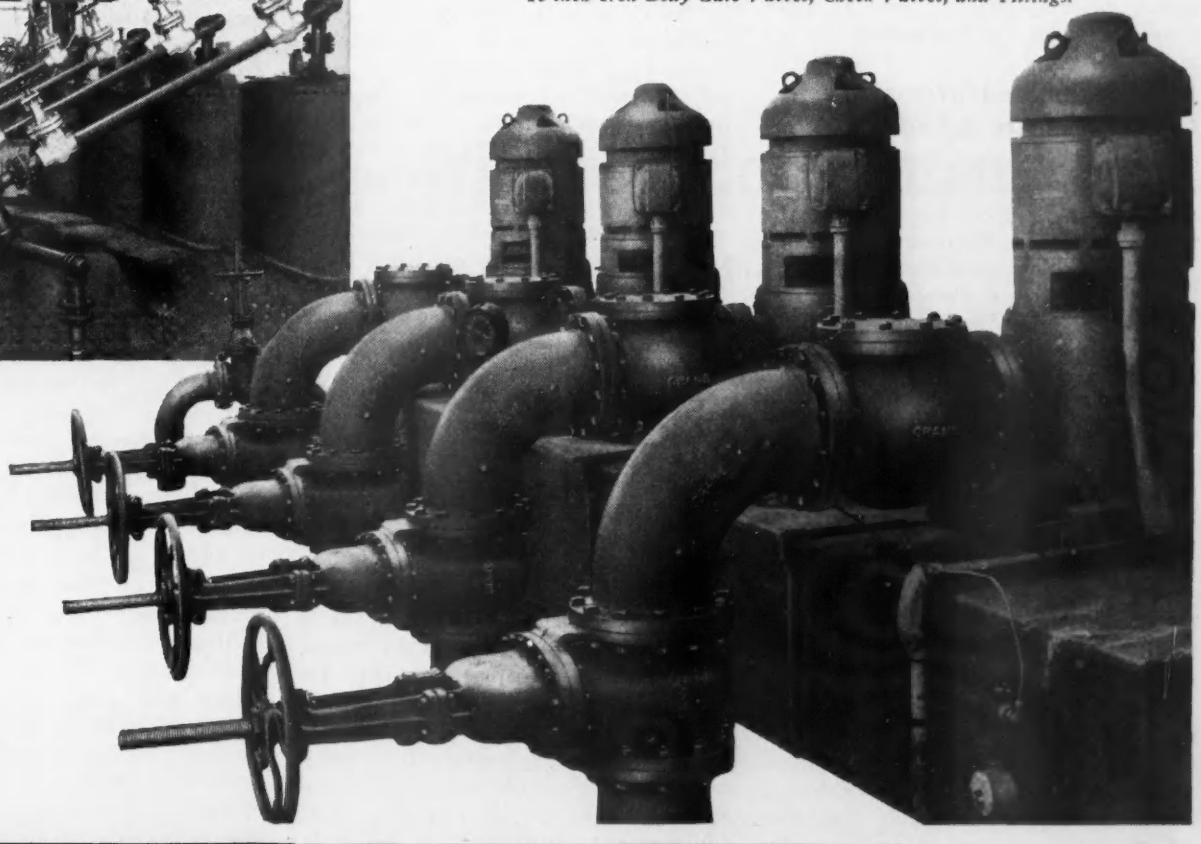

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it would not interfere with the right of Texas and Louisiana to defend their claims to ownership in the suit now before the Supreme Court. In event the U. S. wins in the Supreme Court and Congress fails to enact quitclaim legislation, the states would act as agents of the U. S. in administering present and future leases, subject to review by federal authorities, with federal and state governments sharing in revenue from oil. Under this proposal, a serious deterrent to offshore development would be removed, as desired by all concerned, including the federal government. If the court upholds the states' claims, they lose nothing by the plan, while if it rules against them they would be assured of advantages under the compromise proposal.

President Truman has indicated that he might at least consider the merits of this compromise legislation, although he vetoed a quitclaim bill and has actively asserted the federal government claims. It is felt that the President may yield if urged by Secretary Krug, Attorney General Clark, and other advisers.

Rayburn hopes for Congressional action before adjournment, and Chairman O'Mahoney of the Senate Interior Affairs Committee is ready to sponsor the legislative compromise as soon as complete agreement can be reached.

NPC Recommendations on Oil Imports Are Asked

A particularly significant development in regard to the controversial question of petroleum imports was the June 17 formal request by Secretary of Interior Julius A. Krug for a study of the problem by the National Petroleum Council. He asked NPC to make the study and submit to the government its recommendations on imports and on the question of building up a surplus crude oil producing capacity in the U. S.

Krug said that although NPC suggested a policy on imports in its National Oil Policy report, a more detailed study and recommendations were desirable and necessary. He also said that an NPC study of reserve producing capacity for meeting emergencies would be in the public interest and of great value to the government.

The question of petroleum imports has been given considerable publicity through hearings of the House Small Business Committee, of which Congressman Wright Patman of Texas is chairman. At a hearing in Dallas, statements were offered indicating that a sound national defense policy requires full development of domestic oil and a healthy and prosperous domestic industry; that there is no danger of early exhaustion of U. S. petroleum resources; and that current high imports are a threat to the stability of the domestic industry, adversely affecting drilling, wildcatting, stripper well operations, and employment.

The House Small Business Committee later held hearings at Washington, in which a statement was made by Eugene Holman, president of Standard Oil Company (N. J.), opposing proposed legislation for additional federal government restrictions on imports. As head of the largest importing company, which also has heavy investment in the domestic industry, Holman asserted that fears of a flood of foreign oil imports are unfounded in economics. He said that imports have been generally in conformity with the policy of only supplementing and not supplanting domestic supply. It was in order to be sure of avoiding shortages, as in the winter of 1947-1948, that imports were increased in 1948, Holman stated, and because of contracts, time is required to readjust imports to the new situation of more plentiful supply. He gave figures to show that his company has been reducing imports.

Resources for Manufacture Of Synthetic Oil Studied

Work has been started on a national survey of resources for a domestic synthetic fuel industry, which will be made for the U. S. Army by a group of engineering firms headed by Ford, Bacon & Davis, Inc., New York. About 75 men will be employed on the survey, and work is scheduled to be completed in 18 months.

For the project, the Army awarded a $1,341,637 contract, which includes subcontracts with four other engineering firms and an independent consultant. The survey will determine extent and nature of deposits of coal, natural gas, oil shale, and oil-impregnated strippable deposits which might be available for making synthetic liquid fuels. It will also provide information on water supply, power supply, transportation, housing, availability of labor, and other factors. Data will be obtained from federal, state, and local governments; mining, oil, railroad, and drilling companies; universities and colleges. Data will be correlated, analyzed, and tabulated for a national report and reports by states, indicating general areas suitable for plants. The studies will cover 37 states and Alaska.

Subcontractors employed for the project include the following: for coal studies, Paul Weir & Company, Inc., Chicago; for natural gas and oil shale, DeGolyer & MacNaughton, Dallas; for oil impregnated strippable deposits, Max W. Ball, Washington, D. C.; for water supply studies, Malcolm Pirnie Engineers, New York; and as a consultant on processes, Horace M. Weir, Philadelphia.

Synthetic Liquid Fuels Can Assure Enough Oil

In the face of increasing consumption per capita and an increasing population, present surpluses of oil products will not necessarily be of long duration. In less than a decade, shortages of domestic petroleum can appear, but the problem can be satisfactorily solved by development of synthetic liquid fuels. This view was expressed June 28 by W. C. Schroeder, chief of the Office of Synthetic Liquid Fuels, U. S. Bureau of Mines, before the ASME at San Francisco.

Four courses available to prevent shortages, he said, are (1) importation of petroleum, (2) secondary recovery, (3) development of tidelands oil, and (4) development of synthetic liquid fuels. Probably the most important of these, he said, is development of synthetic liquid fuels. This would insure a liquid fuel supply independent of foreign sources and adequate for centuries, he explained, as well as provide a new American industry.

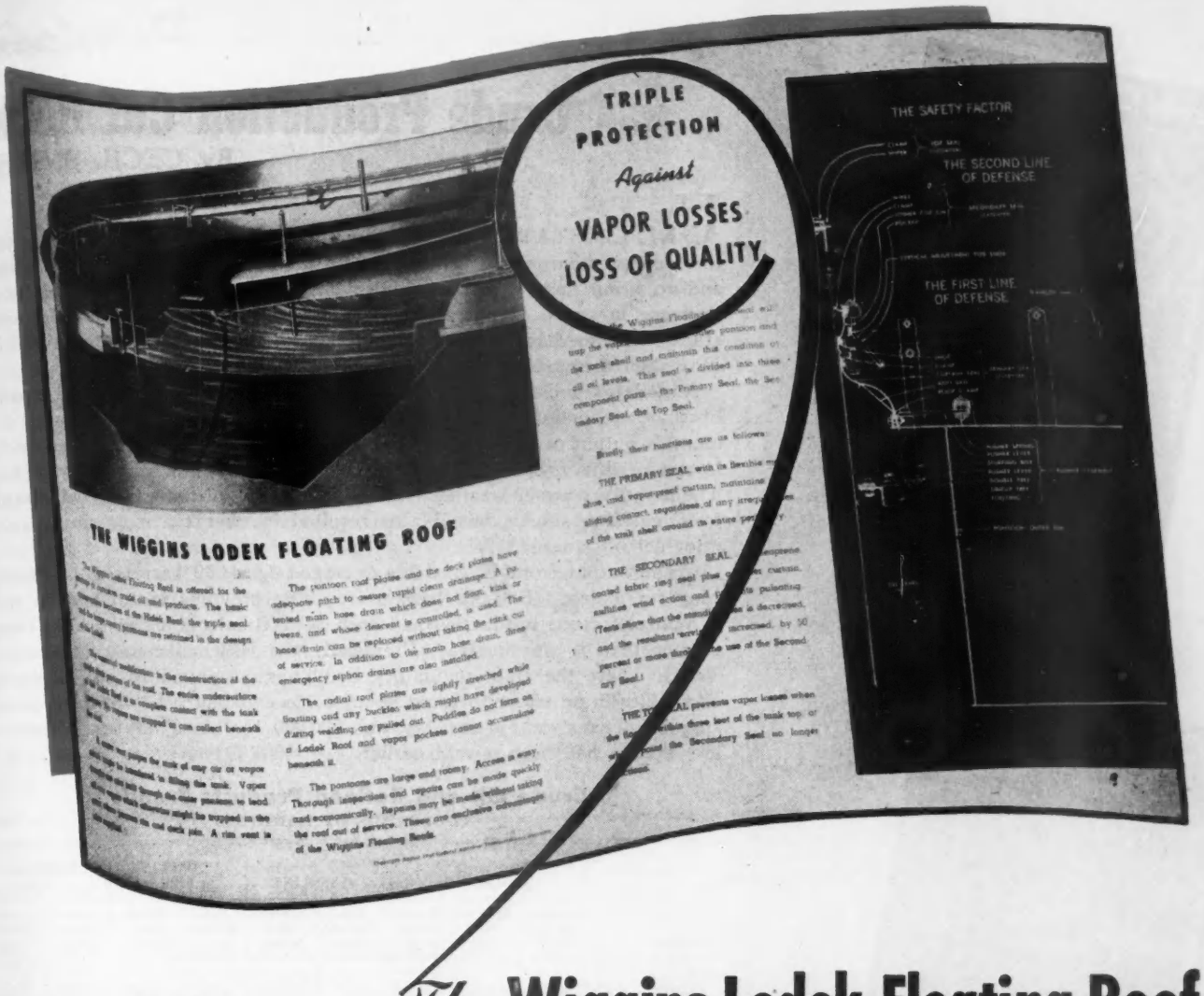
Cost of producing synthetic liquid fuels has been reduced, he said, and refined products such as gasoline, diesel oil, and heating oil can be made from coal and oil shale for as little as 8.4 to 12 cents a gallon.

Excluding profit and interest on plant investment, Schroeder estimated that gasoline can be produced from coal at costs ranging from 9 to 12 cents per gallon. The plant investment would be between $7000 and $8500 for each barrel of capacity per day for plants of 10,000 barrels capacity and over, he said.

The cost of crude shale oil, excluding profit and interest on investment, is approximately $2 per barrel, Schroeder stated. From this he estimated that the cost of gasoline, diesel oil, and heating oil made from the crude shale oil would be about 8.4 cents per gallon. Initial plant investment would be between $4000 and $5000 per barrel per day capacity, he added.

Costs of oil shale products have been brought down by developments in both mining and processing of the oil shale, said Schroeder. Mining costs will be less than 60 cents per ton of shale, he stated, with mechanized mining methods permitting output of over 100 tons per man day underground.

There has been substantial progress also in refining oil shale, he stated, indicating that 75 to 85 percent of crude shale oil can be converted economically into gasoline, heating oil, and diesel fuel. Retorting of oil shale is essentially a simple heating process, said Schroeder, but it still needs study to determine the most efficient equipment.



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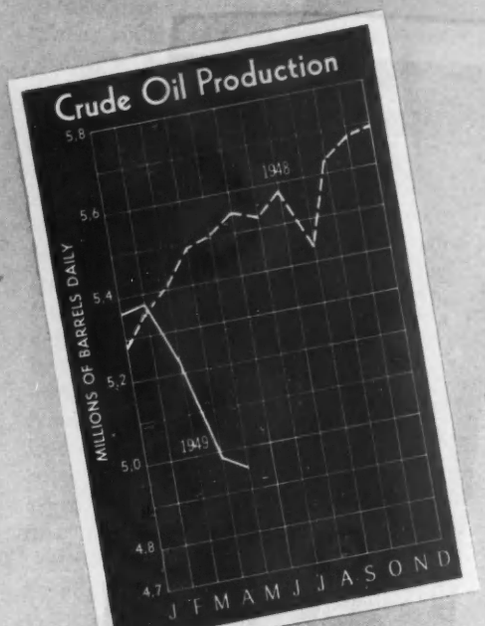
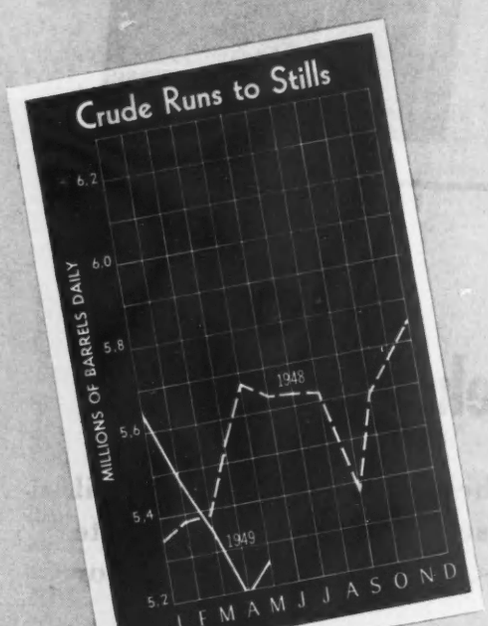
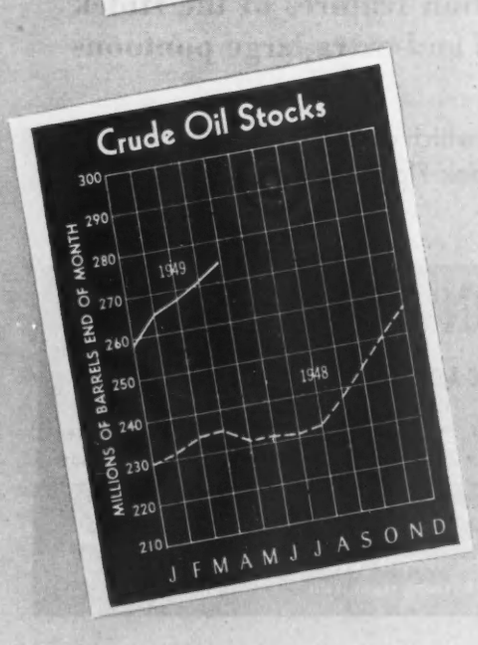






Crude Production Cut Back

By CECIL SMITH.

UNITED STATES crude production was cut back in May for the third consecutive month in an effort to hold back mounting crude stocks and to bring supply and demand more closely into balance. Despite a decrease in crude output and an increase in the amount refined, crude stocks continued to rise and were about 19 percent higher at the end of May than they had been a year earlier.

A moderate increase in refinery activity during May, after several months of sharp reductions, was devoted mainly to gasoline manufacture. The month's output of this product was the highest since last December, while lowered refinery yields of fuel oils dropped output to a new two-year low. The month's warmer weather resulted in substantial reductions being made from gasoline stocks, but it also resulted in over twice as much going into fuel oil storage.

Crude output from U. S. fields averaged 4,954,000 barrels a day during May for a drop of 31,000 barrels from the previous month's daily rate. A year ago crude production had been 548,000 barrels a day or 10 percent greater than it was in May. Practically the entire decrease occurred in Texas, where the state regulatory body has continued to cut producing allowables in an effort to bring about a closer balance between needs and supplies. Texas' output in May was 540,000 barrels a day or 22 percent less than it had been a year earlier.

Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1946:									
January	4,625	4,520	227,996	1,914	102,394	787	28,990	1,224	34,573
February	4,719	4,651	231,827	1,884	104,836	823	25,511	1,243	34,008
March	4,414	4,661	225,928	1,900	104,161	815	29,922	1,213	32,995
April	4,673	4,663	227,013	1,943	98,744	773	32,064	1,247	35,206
May	4,785	4,794	226,505	2,016	93,960	753	33,385	1,220	38,932
June	4,896	4,836	228,064	2,055	91,971	777	38,824	1,219	41,492
July	4,922	4,856	229,319	2,102	87,778	793	46,439	1,163	45,446
August	4,836	4,856	229,223	2,189	86,745	765	54,068	1,159	48,186
September	4,790	4,839	227,818	2,143	87,021	796	62,019	1,150	54,012
October	4,785	4,736	227,660	2,117	85,952	788	76,780	1,090	55,580
November	4,823	4,684	231,788	2,162	88,587	791	68,145	1,101	52,735
December	4,725	4,789	230,176	2,168	92,742	805	59,912	1,159	47,094
1947:									
January	4,671	4,739	229,432	2,078	99,623	778	48,197	1,174	41,550
February	4,810	4,820	230,911	2,089	103,672	777	36,901	1,228	48,480
March	4,908	4,843	234,980	2,076	105,679	825	31,423	1,222	37,403
April	4,974	4,707	241,663	2,037	101,724	764	30,268	1,148	36,455
May	5,033	4,947	243,593	2,128	95,209	805	34,279	1,204	39,992
June	5,099	5,120	242,707	2,258	89,774	807	39,676	1,233	43,515
July	5,137	5,221	236,182	2,302	86,003	847	46,444	1,244	47,600
August	5,173	5,260	233,843	2,383	85,849	869	54,707	1,245	51,334
September	5,251	5,236	230,452	2,375	84,360	911	59,764	1,237	52,578
October	5,320	5,253	231,941	2,371	82,584	938	63,252	1,260	52,502
November	5,291	5,291	231,085	2,332	87,551	942	61,324	1,245	52,455
December	5,337	5,350	230,654	2,347	92,303	992	51,081	1,282	47,091
1948:									
January	5,283	5,348	229,842	2,328	102,167	1,082	41,036	1,278	44,636
February	5,353	5,380	231,419	2,264	110,999	1,127	34,590	1,295	43,156
March	5,406	5,387	234,164	2,252	111,949	1,050	32,124	1,307	41,945
April	5,484	5,540	234,506	2,396	109,289	978	34,514	1,303	43,301
May	5,502	5,668	231,318	2,486	108,552	992	40,781	1,314	48,518
June	5,544	5,632	231,412	2,529	104,518	998	48,352	1,280	52,465
July	5,522	5,631	230,955	2,494	98,839	994	58,725	1,264	58,431
August	5,577	5,621	231,954	2,532	95,445	1,038	68,818	1,248	64,096
September	5,435	5,376	237,302	2,416	90,518	961	76,320	1,154	68,005
October	5,632	5,594	243,972	2,490	92,426	1,069	82,920	1,268	72,363
November	5,675	5,672	250,066	2,551	95,589	1,081	83,909	1,277	77,033
December	5,688	5,720	256,254	2,626	103,697	1,106	*75,953 †71,381	1,299	*76,942 †63,993
1949:									
January	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	933	48,923	1,258	58,190
April	4,985	5,175	271,255	2,490	124,787	902	49,959	1,168	60,174
May	4,954	5,257	275,118	2,562	119,995	853	57,096	1,170	63,552
May, 1949 Changes:									
In Month	—31	+82	+3,863	+72	—4,792	—49	+7,137	+2	+3,378
In One Year	—548	—411	+43,800	+76	+11,443	—139	.....	—144	.....
In Two Years	—79	+310	+31,525	+434	+24,786	+48	.....	—34	.....

* For comparison with prior months. † For comparison with subsequent months.

Trends

for Third Consecutive Month

Staff Writer

U. S. production was slated to be reduced even further for the next several months. Texas' allowables for June were lowered and further reductions were set for July and August. Louisiana and Arkansas also announced cuts in their allowable rates.

Lowered production rates in June have already had effects on crude stocks as they had not increased by the middle of the month. Production cutbacks scheduled for July and August should result in substantial reductions in stocks as supply and demand were fairly well balanced during the first half of June.

Crude stocks totaled 275,118,000 barrels at the end of May after gaining 3,863,000 barrels. These were 43,800,000 barrels or 18.9 percent greater than stocks a year ago. However, by June 18 stocks had not increased further and actually were down slightly to 274,956,000 barrels.

Runs to refinery stills during the month averaged 5,257,000 barrels a day for an increase of 82,000 barrels daily over April's rate. This was the first upward swing in refining activity since December of last year when runs were at an all-time high. Despite the hike, May's runs were 411,000 barrels a day less than those of a year ago.

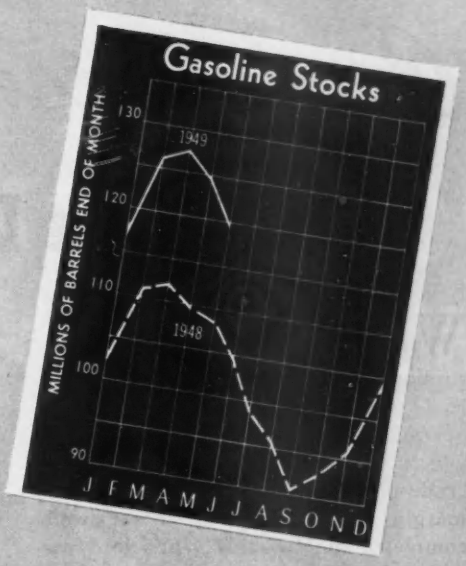
Gasoline production was raised 72,000 barrels daily during the month to average 2,562,000 barrels a day, the highest since December. Stocks of gasoline were reduced 4,792,000 barrels during the period and ended totaling 119,995,000 barrels.

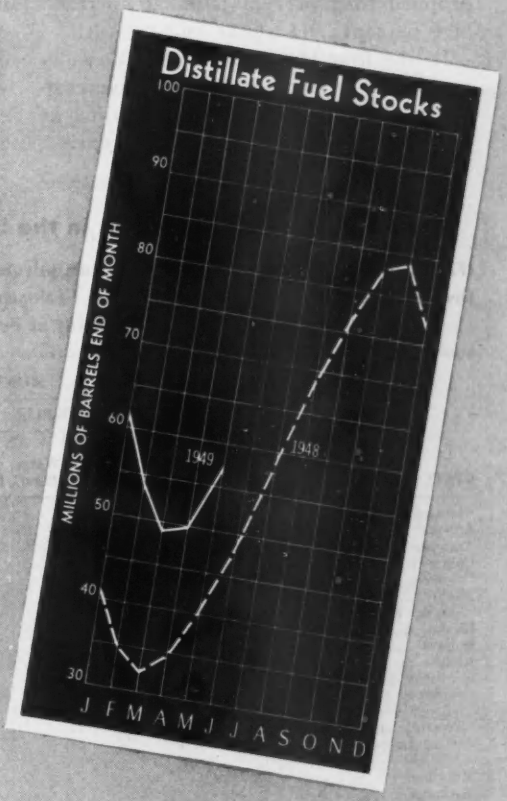
Stocks of distillate and residual in 1949 do not include California cracking stocks, etc., which were included in 1948, and which on Dec. 31, 1948, amounted to 4,572,000 barrels of distillate and 12,949,000 barrels of residual.

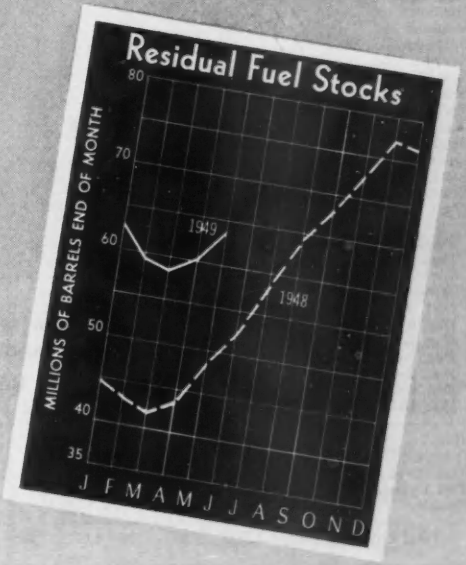
State Crude Oil Production

(THOUSANDS OF BARRELS)

STATE OR DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST FIVE MONTHS		
	May, 1949	April, 1949	May 1948	% Diff. May'48-'49	1949	1948	% Diff. '48-'49
Alabama	1.2	1.2	1.4	— 14.3	185	190	— 2.6
Arkansas	85.1	86.4	84.9	+ 0.2	12,949	13,024	— 0.6
California	938.8	949.3	946.3	— 0.8	142,694	142,708	.....
Colorado	65.4	66.6	46.6	+ 40.3	9,825	6,889	+ 42.6
Florida	1.3	1.5	0.7	+ 85.7	194	118	+ 64.4
Illinois	178.9	177.4	173.5	+ 3.1	26,352	26,275	+ 0.3
Indiana	24.6	23.4	17.6	+ 39.8	3,487	2,341	+ 49.0
Kansas	290.2	292.1	312.5	— 7.1	44,031	44,592	— 1.3
Kentucky	23.8	23.3	23.1	+ 2.1	3,479	3,554	— 2.1
Louisiana	518.3	510.7	491.8	+ 5.4	78,090	73,108	+ 6.8
North Louisiana	121.2	121.3	118.8	+ 2.0	18,455	17,606	+ 4.8
South Louisiana	397.1	389.4	373.0	+ 6.5	59,635	55,502	+ 7.4
Michigan	41.6	44.0	43.5	— 4.4	6,747	6,810	— 0.9
Mississippi	108.4	109.8	123.1	— 11.9	16,648	18,144	— 8.2
Missouri	0.1	0.1	0.2	— 50.0	14	23	— 39.1
Montana	25.3	23.9	24.9	+ 1.6	3,731	3,709	+ 0.6
Nebraska	0.3	0.3	0.8	— 62.5	77	98	— 21.4
New Mexico	128.8	130.6	128.8	.....	19,991	19,491	+ 2.6
New York	13.8	13.9	12.5	+ 10.4	1,932	1,909	+ 1.2
Ohio	9.9	9.5	8.8	+ 12.5	1,422	1,314	+ 8.2
Oklahoma	429.1	407.5	417.8	+ 2.7	63,898	61,862	+ 3.3
Pennsylvania	30.2	29.9	34.5	— 12.5	4,763	5,257	— 9.4
Tennessee	.....	.....	.....	.....	3	3	.....
Texas	1,913.9	1,951.5	2,453.9	— 22.0	322,472	367,460	— 12.2
Dist. 1—South Central	25.8	25.4	26.9	— 4.1	4,015	3,934	+ 2.1
Dist. 2—Middle Gulf	121.5	124.8	172.0	— 29.4	21,458	25,987	— 17.4
Dist. 3—Upper Gulf	373.5	382.7	493.1	— 24.3	63,555	75,156	— 15.4
Dist. 4—Lower Gulf-SW.	187.6	189.6	255.6	— 26.6	31,270	39,685	— 19.2
Dist. 5—East Central	34.8	36.2	46.4	— 25.0	6,173	6,817	— 9.4
Dist. 6—Northeast	335.7	345.1	425.8	— 21.2	57,084	65,670	— 13.1
Dist. 7-B—N. Central	56.9	58.7	45.2	+ 25.9	9,193	6,710	+ 37.0
Dist. 7-C—W. Central	42.3	42.8	45.0	— 6.0	6,953	6,700	+ 3.8
Dist. 8—West	520.7	539.6	688.0	— 24.3	90,837	102,046	— 11.0
Dist. 9—North	126.1	118.9	138.5	— 9.0	19,581	21,256	— 7.9
Dist. 10—Panhandle	89.0	87.7	84.6	+ 5.2	13,377	13,092	+ 2.2
Utah	0.5	0.3	.....	.....	37	.....	.....
Virginia	0.1	0.1	0.2	— 50.0	13	21	— 38.1
West Virginia	7.8	7.5	7.2	+ 8.3	1,120	1,095	+ 2.3
Wyoming	116.2	123.7	147.8	— 21.4	18,492	21,686	— 14.7
Total United States	4,953.6	4,984.5	5,502.4	— 10.0	782,646	821,681	— 4.8







Completions

Reflect Decline in Crude Prices

WHILE this year's drilling activity continued through May to hold onto a lead over last year's record-breaking operations, a slackening in some regions, which was due principally to lowered crude prices, is beginning to narrow the margin. As a result of fewer wells completed in May this year's lead was dropped to 4 percent from an increase of 6 percent held at the end of April.

In the first five months of 1949 wells completed totaled 15,123 for an increase of 3.9 percent over the 14,560 drilled in the same period of 1948. A month earlier this year's completions outnumbered those of last year by 5.9 percent. However, total footage drilled in 1949 has amounted to almost 10 percent more, reflecting the increased drilling in deeper areas and cutbacks in the relative shallow regions.

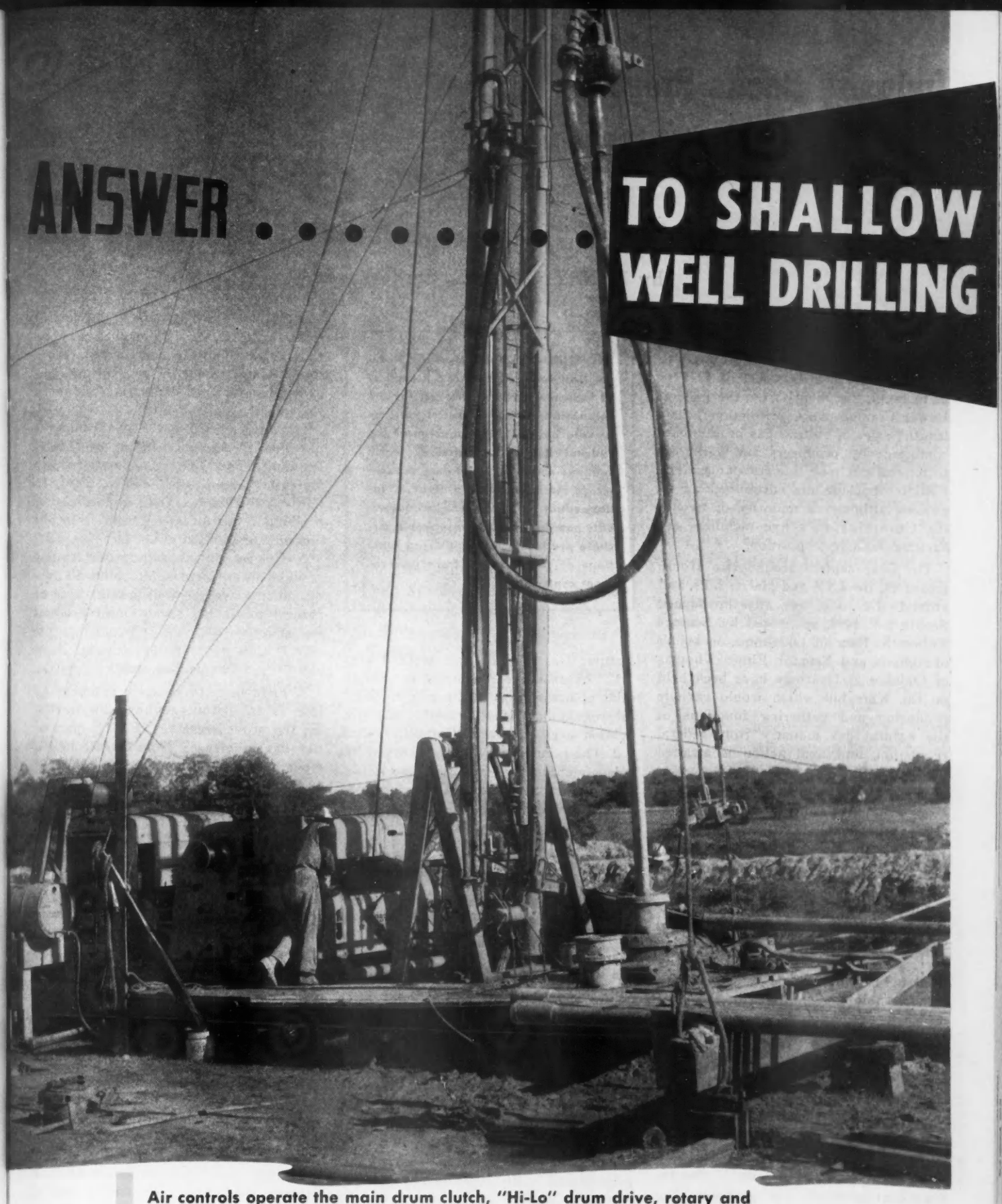
Lowered crude prices have played an important part in the slackening of drilling rates in particular parts of the country. In the Appalachian Region, where prices have been reduced substantially, drilling has consistently declined. In the first five months Pennsylvania's total wells had dropped almost 30 percent from the 1948 total, and West Virginia's decreased more than 40 percent. New York's and Ohio's wells dropped 24 and 11 percent respectively.

On the other hand Texas' wells have totaled almost 20 percent more than last year's and Oklahoma's were up better than 5 percent. California, Wyoming, Illinois, Indiana, Kentucky, and Michigan also upped their drilling rates, but it seems to be only a matter of time before this year's wells begin to trail last year's record.

Well Completions in the United States During May, 1949, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from The Producers Monthly)

STATE OR DISTRICT	MONTHLY COMPLETIONS, MAY, 1949									TOTAL COMPLETIONS				CUMULATIVE TOTAL				Rigs in Operation (Drilling, Rigging Up and Shut Down)		
	NEW WELLS								Total Drilled Deeper											
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New		May 1949	April 1949	May 1948	Footage May, 1949	Wells 1949	Wells 1948	Percent Diff.	Footage 1949	May 31, 1949	April 30, 1949	May 31, 1948
Alabama											4	2		6	6		33,359	4	3	4
Arizona														3			7,766	6	6	7
Arkansas	16	1		8				25	2	27	27	22	100,111	114	114		488,708	35	32	39
California	170			47				217	3	220	240	213	896,376	1,092	1,017	+ 7.4	4,228,509	267	256	280
Colorado				11				11		11	4	18	30,602	24	104	— 76.9	94,623	18	21	54
Florida											1	2		8	10	— 20.0	54,803	2	3	4
Georgia								1		1	1			4	2	+100.0	12,437	1	1	
Illinois	123			122				245	1	246	183	238	627,131	868	794	+ 9.3	2,215,041	275	257	253
Indiana	64			65				129		129	75	104	262,275	431	380	+ 13.4	827,361	137	134	106
Kansas	130		15	102			1	248		248	215	284	831,943	1,102	1,077	+ 2.3	3,697,496	314	312	285
Kentucky	26		24	21		1		72		72	62	68	126,020	348	280	+ 24.3	626,902	84	83	84
Louisiana	94	9	18	52				173		173	141	200	983,566	773	808	— 4.3	4,591,525	236	195	233
North Louisiana	57	4	15	21				97		97	76	137	341,506	387	512	— 24.4	1,343,867	71	52	79
South Louisiana	37	5	3	31				76		76	65	63	642,060	386	296	+ 30.4	3,247,658	165	143	154
Maryland															1	—100.0				
Michigan	38		1	35				74		74	76	53	154,261	369	246	+ 50.0	827,752	130	103	127
Mississippi	13			17				30		30	30	36	213,689	143	159	— 10.1	1,081,920	26	31	52
Missouri			2					2		2	3	5	578	7	26	— 73.1	3,096	5	6	5
Montana	15		1	6				22		22	22	32	59,455	88	120	— 26.7	252,194	51	38	48
Nebraska															1	—100.0		1	1	
Nevada																		1	1	1
New Mexico	31		4	13				48	4	52	61	43	197,954	238	258	— 7.8	1,005,279	93	93	130
New York	32				21			53		53	90	135	74,603	526	689	— 23.7	737,990	109	121	168
North Dakota																		1	1	
Ohio	37		25	40				102	1	103	83	124	203,141	449	504	— 10.9	1,016,361	134	141	216
Oklahoma	178		23	142			2	345	6	351	428	337	1,190,801	1,667	1,585	+ 5.2	6,085,989	486	482	580
Pennsylvania	49		22	6	46	5		128	2	130	173	268	238,932	937	1,298	— 27.8	1,646,711	241	291	396
South Dakota															1	—100.0		2	1	
Tennessee	2			3				5		5	3	7	5,119	14	21	+ 33.3	14,376	6	9	20
Texas	656	24	17	365	2	1		1,065	27	1,092	1,233	917	4,603,503	5,461	4,571	+ 19.5	23,480,098	1,260	1,245	1,440
Dist. 1—S. Central	20			24				44	1	45	52	33	125,148	246	203	+ 21.2	703,001	43	44	47
Dist. 2—Middle Gulf	28	6	2	14				50	4	54	80	70	314,840	270	328	— 17.7	1,620,910	45	46	59
Dist. 3—Upper Gulf	46	10	2	30		1		89	2	91	113	87	553,853	527	405	+ 30.1	3,318,122	137	144	137
Dist. 4—Lower Gulf-SW	45	5	5	55				110	3	113	120	115	524,684	623	545	+ 14.3	3,085,521	106	101	112
Dist. 5—E. Central	8			7				15		15	30	18	73,618	106	75	+ 41.3	492,929	16	17	35
Dist. 6—Northeast	77	2	3	14				96	4	100	64	21	393,972	403	149	+170.5	1,744,918	42	34	51
Dist. 7-B—N. Central	80	1	1	80				162	3	165	202	99	488,613	775	511	+ 51.7	2,369,635	159	164	163
Dist. 7-C—W. Central	37		2	26				65		65	50	20	339,551	176	141	+ 24.8	856,010	57	51	88
Dist. 8—West	226		1	35				262	10	272	279	222	1,277,564	1,135	1,137	— 0.2	5,683,478	393	397	490
Dist. 9—North	89		1	79	2			171		171	243	181	502,002	960	847	+ 13.3	2,754,211	135	129	104
Dist. 10—Panhandle				1				1		1		51	9,658	240	230	+ 4.3	851,363	127	118	160
Utah	5			1				6		6	2	1	25,704	17	9	+ 88.9	79,688	18	16	10
Virginia															1	+100.0				
Washington															1	+100.0				1
West Virginia	1		27	4				32	1	33	37	63	97,601	187	314	— 40.4	542,406	240	284	378
Wyoming	23			17				40		40	74	42	180,395	247	163	+ 51.5	1,174,989	94	99	140
Total United States	1,703	34	179	1,077	69	7	3	3,073	47	3,120	3,232	3,214	11,108,642	15,123	14,560	+ 3.9	54,827,379	4,277	4,266	5,067



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Industry Backs Proposal to

Curb FPC Powers

In Sales of Natural Gas

By HENRY OZANNE, Staff Writer

PROPOSED AMENDMENT of the Natural Gas Act is receiving full support of industry leaders who call for the relaxation of federal restrictions on private business. The position of the Federal Power Commission, which seeks to retain its regulatory authority, is stated as well as that of independent natural gas producers. Bills now before Congress would exclude producing and gathering functions of the industry from government controls.

SOLID industry support has been thrown behind the current proposal to amend the Natural Gas Act of 1938 so as to exempt explicitly from the Federal Power Commission's jurisdiction "arm's length" sales of natural gas in interstate commerce by producers and gatherers to natural gas pipe line companies. The FPC is opposing the curtailment of its powers, although a minority of two of the Commission's five members are backing industry's position.

The issue centers around two House measures, the Lyle and Harris bills, and around the more recently introduced Senate Bill 1498, sponsored by Senator Robert S. Kerr of Oklahoma on behalf of himself and Senator Elmer Thomas of Oklahoma. Hearings have been held on the Kerr bill which would exclude producing and gathering functions of the natural gas industry from federal regulation, and final action is awaited by Congress.

Act Ambiguous

Present wording of the Natural Gas Act is ambiguous as to the jurisdictional extent of FPC's powers. Previously the Commission had declared that it regarded gathering and producing functions outside its regulatory right, and issued Order 139 to that effect. However, a recent change in FPC majority thinking has been made, and the Commission now holds, three to two, that no such exemption is provided under the law. The two minority members, Harrington Wimberly and Commission Chairman Nelson Lee Smith, hold with industry:

"We do not subscribe to the view that it would be adverse to the public interest to amend the Natural Gas Act so as to clarify the status of the independent producer and gatherer. The legislative history shows clearly that Congress did not intend to assert jurisdiction over such producers and gatherers by bringing them under regulation by the Federal Power Commission. The Commission has repeatedly stated this view. We see no reason for arriving at a different conclusion now."

Industry's chief objections to the Natural Gas Act as now worded are:

1. Congress never intended to subject sales of natural gas in the field to federal regulation. This formerly was the opinion even of the FPC itself.

2. The regulation of prices charged by independent natural gas producers would also subject oil operations of such producers to federal regulation.

3. Natural gas producers now live, as Ernest O. Thompson of the Texas Railroad Commission says, in fear of being subjected to the utility provisions of the act, and of having their returns limited to the 6 percent rate which would not carry the burden of other losing investments.

4. The gas conservation program is suffering because of the fear of producers that if they sell their gas to an interstate pipe line, they will find themselves federally regulated.

5. Vigorous competition, not regulations, is the best stabilizer of the natural gas industry among its thousands of small producers.

6. The enactment of the proposed amendment would result in reducing the price of gas to the consumer by making more gas available.

Chief opposition to restricting the Commission's jurisdiction comes from Commissioner Leland Olds who, after several switches in opinion, now contends that only about 10 percent of the natural gas producers should be regulated, but that FPC should have the power to decide where to apply federal controls.

The majority of FPC argues that the natural gas industry has thrived rather than suffered under the present act, and in support of that contention advances the following argument:

1. Between 1938 and 1948 the natural gas market has more than doubled. Interstate pipe line transportation has increased from 1,636 billion to 3,511 billion cubic feet a year, and total net production has increased from 2,945 billion to 5,650 billion cubic feet.

2. This rapidly expanding market has resulted in an increase of about 50 percent in the average well-mouth value of natural gas in the seven major producing states.

Ample Rewards

3. Field price levels have not been so low as to discourage new discoveries, for the proved reserves of U. S. natural gas have increased from 70,000 billion cubic feet in 1938 to 174,000 billion in 1948, an increase of about 150 percent.

4. The financial rewards of the interstate pipe lines have been large enough to encourage huge expansion of capacity. Since February, 1942, FPC has authorized 22,500 miles of interstate natural gas pipe lines, representing an investment of more than $1,200 million. Construction expenditures by all gas companies in 1938 totaled $79 million, but they increased every year until for 1948 they totaled $675 million. The American Gas Association estimates that natural gas construction expenditures will aggregate $1,900 million for the four-year period 1949 to 1952.

5. Financial indices reveal the outstanding prosperity of the natural gas industry under the Natural Gas Act. From 1937 to 1947, for instance, the net investment per dollar of revenue decreased from $3.10 to $2.40, establishing a position more favorable than that of electric utilities.

6. Trend of cost of debt capital for the natural gas industry has been more favorable than that of electric utilities, representing a signficant change in relative position since the beginning of regulation under the present act.

7. Under the act, great reductions have

■ CONTINUED ON PAGE 42

STREAMLINING Office Records

By DR. CLARENCE M. UPDEGRAFF
Legal Consultant,
National Association of Purchasing Agents

RECORDS are essential to the successful operation of business. Yet, as they accumulate, the company has filing and storage problems which management finds difficult to control. Ordinarily, the solutions to problems of this type may be found in the company manual where well-defined procedures are spelled out for all departments. But schedules and procedures for records retention appear to be the exception rather than the rule. Inquiry reveals that more often extreme practices are employed, ranging from promiscuous destruction of all records at periodic intervals to indefinite retention and resultant overcrowding of files. Either practice incurs unnecessary expense and inconvenience. Indiscriminate destruction of records may be as harmful as overcrowding the files with dead matter which permits vitally important records to become misfiled, perhaps lost, increase handling expenses, storage space and costs.

Furthermore, considerable divergence of opinion is found among business concerns as to the best method of attacking the problem. As a matter of fact, wide differences of opinion exist among the individual executives within the same organization. An exception to this practice might be found among public service groups such as railroads, utilities, financial institutions and governmental agencies. Legislation and official rulings prescribe the period of retention of certain records for these industries. But private business, although subject to a few of these government regulations, has not found them universally adaptable to its particular needs.

RECORDS NECESSARY for the operation of a business involve difficult problems of filing and storage. To solve these problems, well planned schedules and procedures for retaining and discarding records are needed.

For maintaining records and reference material systematically, various plans have been worked out by research organizations. These plans offer valuable suggestions for procedures that may be followed.

Under each of the plans, every record is classified according to its use or function, retention value, and suitable disposal, and under some plans, definite suggestions are made on the retention period for each classification.

Suggested Procedures

Attempts have been made by research organizations to classify each record according to its use, retention value and suitable disposal. Several of the plans are outlined briefly and illustrate that a uniform procedure may be adopted. While the proposed plans differ somewhat in their approach to the problem, nevertheless, they are based on the same fundamental policy: to review each record according to its function and determine from that its importance as reference material.

According to a plan suggested in a survey by the Metropolitan Life Insurance Company Service Bureau, the possible future value of any given record or document depends on a number of factors, the more important of which are as follows:

1. The nature of the document, and its significance in connection with future company activities.

2. The availability, in other files, of identical copies of the same records.

3. The extent to which the data involved summarizes, or is summarized, by other available records.

4. The degree to which the material in question provides essential details of some basic record.

Analyzing each record according to the above factors may reveal a large mass of filed information which could not be of any conceivable future value for reference purposes. It should also show that the value of records may be measured according to frequency of reference, which means some records may be vital for a brief period but lose their significance afterward, while there may be other records which are subject to longer periods of review, but finally become obsolete and have no permanent value.

The procedure offered in the Business Historical Society of Boston would first determine which records or documents may be simplified, combined, standardized or eliminated. Once this determination is made, records are then classified and retained on the following basis:

1. Records which, according to legal requirements, are permanent.

2. Records which, for operating or historical reasons should be permanently preserved in their entirety.

3. Records which, for legal or operating reasons, should be kept for a certain period of years (usually three to seven). The status of these records is further broken down into two groups:

   (a) Those that may ultimately be entirely destroyed.

   (b) Those from which a sampling or selection should be taken for permanent preservation before the destruction of the remainder.

4. Records which may, from a legal or company standpoint, be destroyed as soon as their current usefulness has ceased, but from which a sampling or selection should be taken for permanent preservation before the others are destroyed.

5. Records which should be entirely

destroyed as soon as they have ceased to be of current use.

Under this plan the material is not only classified but more definite suggestions are made on the retention period for each classification.

Where storage facilities are limited, as is the case with many small and even medium-sized concerns, it might be advisable to streamline this plan somewhat and consider it under the following headings:

1. VITAL: Include basic records giving direct evidence of legal status, ownership, assets, liabilities, and other records of operation which are irreplaceable and the loss of which would cause great inconvenience.

2. IMPORTANT: Records which are essential to the continuous operation of the business but which could be reproduced from the vital records, although at considerable expense. The great bulk of records used in current operations will fall into this group, especially information data used to inventory values, production costs, etc.

3. USEFUL: Records which would cause temporary inconvenience but would entail no serious disadvantage if lost. This group should include such material as routine correspondence, apart from important letters which are classified in 1 and 2.

4. NONESSENTIAL: Records which are of secondary importance to current operations and have no permanent value. Material in Class 4 of the preceding plan would be most likely to fall in this group.

Housing Records

In conjunction with the determination of the retention period of each record, the executive must also consider and plan for the physical housing of the record during its life span. Frequency of reference to the particular record will be the governing factor in this instance. In other words, a record is first housed in the active files and will remain there until reference to it becomes relatively "infrequent." If, according to the retention schedule, it is to be retained beyond this point, it is sent to the semi-active files. As reference to the record drops to "seldom," it is removed from these files and either sent to storage or destroyed. In small organizations semi-active files are probably not practical, in which case the record passes from the active file directly to storage or destruction depending on the retention classification.

Legal Aspects

No procedure, however, should be adopted without due consideration and respect being given to the legal consequences involved. In many business concerns the retention policy is based primarily on the state Statute of Limitations in the firm belief that, in abiding by these statutes, the organization will be safeguarded against all possible legal actions. Strict adherence to the Statutes of Limitations and the saving of all papers against the possibility of litigation means a large volume of material constantly on file and may result in disorder and confusion.

Period of Retention

The period of time within which action may be brought on merchandise contracts evidence by informal writings, correspondence, purchase orders, etc., is shown in the following Statutes of Limitations:

Within three years: District of Columbia, Maryland, North Carolina.

Within four years: California, Canal Zone, Puerto Rico, Texas.

Within five years: Arkansas, Florida, Idaho, Kansas, Nebraska, Oklahoma, Virginia.

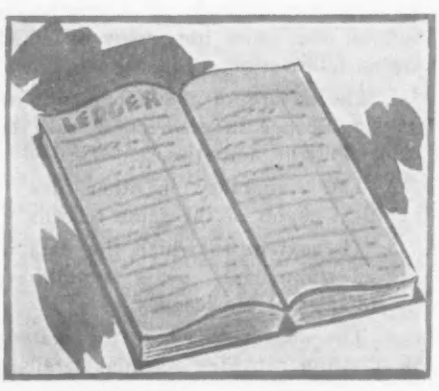
Within six years: Alabama, Alaska, Arizona, Colorado, Connecticut, Delaware, Georgia, Hawaii, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Washington, Wisconsin.

Within eight years: Montana.

Within ten years: Illinois, Indiana, Iowa, Louisiana, Missouri, West Virginia, Wyoming.

Within fifteen years: Kentucky, Ohio.

Policies which underlie Statutes of Limitations Acts have been variously explained. For instance, some early judges thought the legislatures meant only to protect persons who had paid their debts, but because of length of time, had destroyed the proof of payment. Other commentaries find there is an inherent weakness in any old and stale claim which ordinarily can be proved only by evidences palsied by age and defended by testimony of like frailty. It is interesting to note that whereas courts of equity are not bound to act in obedience to the Statutes of Limitations, they have evolved their own doctrine of laches by means of which relief is refused to petitioners who fail to assert their claims for such length of time that their enforcement ultimately becomes unconscionable, which is to say, inequitable.



An organization, to safeguard itself against all possible legal actions, might adopt the following policy:

1. Keep all original records, if possible, and keep them well filed and indexed for use in the indefinite future. Discard duplicates made only for intrafirm use.

2. If the course mentioned in the preceding paragraph cannot be followed, make it at least a part-time duty of one responsible employe to study the retention of papers and documents for the firm.

3. Ascertain the types of transactions most likely to result in litigation or other legal disputes, such as labor controversies, tax claims, contracts, etc., and keep these documents beyond the Statutes of Limitations period in the state in which the company operates. If the transactions figure in interstate business where the limitations of each state differ, keep them for the longest period of limitation.

4. If there have been claims made in respect to any specific purchases or sales transactions and these have required correspondence and settlements, retain the files concerning them beyond the longest period of limitations possibly applicable, even though the files contain signed memoranda or settlements and releases. These last mentioned documents may be the very ones needed in the future.

5. Retain indefinitely all deeds, mortgages, releases and similar formal legal papers.

6. If microfilm is used, restrict its use, if possible, to company historical documents rather than to legal or legal-historical documents.

Although adherence to these suggestions means a huge volume of records still being carried in the files, it is the only means of securing adequate protection against legal action. If some records must be eliminated it is suggested that simple correspondence, purchase orders, and other records involving innumerable routine transactions which are not likely to result in litigation and have not become the subject of special correspondence or dispute within a period of two years, be discarded. Certainly all duplicates made for intrafirm purposes should be dispensable by that time. More will be gained by eliminating this old volume

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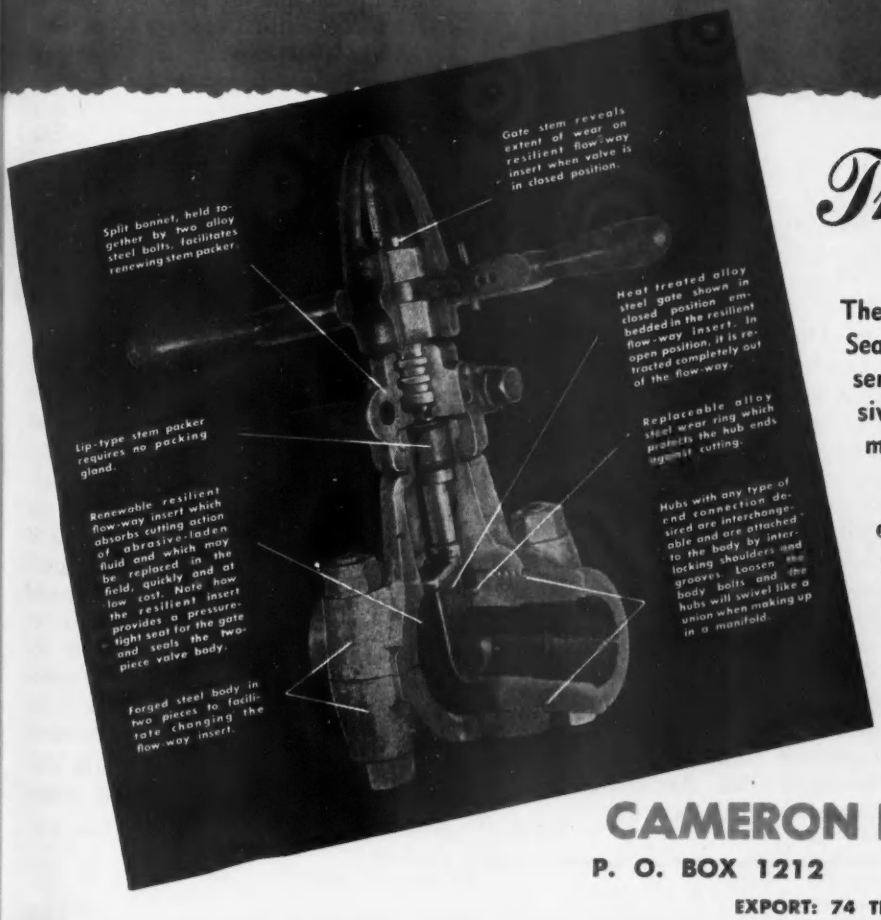
Split bonnet, held together by two alloy steel bolts, facilitates renewing stem packer.
Gate stem reveals extent of wear on resilient flow-way insert when valve is in closed position.
Heat treated alloy steel gate shown in closed position embedded in the resilient flow-way insert. In open position, it is retracted completely out of the flow-way.
Lip-type stem packer requires no packing gland.
Replaceable alloy steel wear ring which protects the hub ends against cutting.
Renewable resilient flow-way insert which absorbs cutting action of abrasive-laden fluid and which may be replaced in the field, quickly and at low cost. Note how the resilient insert provides a pressure-tight seat for the gate and seals the two-piece valve body.
Hubs with any type of end connection desired are interchangeable and are attached to the body by interlocking shoulders and grooves. Loosen the body bolts and the hubs will swivel like a union when making up in a manifold.
Forged steel body in two pieces to facilitate changing the flow-way insert.

The Inside Story

There is no other valve like the Cameron Flex-Seal. It was designed for one service and one service only . . . drilling mud and similar abrasive fluids which quickly cut out the metal-to-metal seal in ordinary all-purpose valves.

The *inside story* of the valve that has revolutionized mud line manifolding is presented at left. Operators who may not be familiar with its unique design are invited to study this sectional view or, better still, order a few Flex-Seals and check their performance under actual operating conditions.

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of paper than can possibly be lost by the off-chance that some of it may become important in establishing a legal claim. Moreover, assuming that a particular transaction gets into the courts, it is not always necessary to rely on correspondence, purchase orders, bills of lading, vouchers, etc. Railroad records, bank records, and, at times, documents of other parties interested in the transaction may be discovered to support permanent book records of the defendant.

Therefore, it remains the responsibility of the individual executive to protect adequately the legal rights of his company when setting up the records retention schedule. He must ask himself this question and make his decisions accordingly: "Granted that in the huge accumulation there are some which might one day be needed for evidence, is it sound to gamble the certain advantage of eliminating great volumes of paper, much of which will have no value, against the disadvantage of a thinly possible future need for a few sheets from one file when the same is not available?"

Microfilm Reproduction

The introduction of microfilming of records was hailed initially as the answer to many filing problems. By this process, 3000 letter-size documents can be reproduced on a 100-foot roll of microfilm. Reports indicate that 99 percent of the floor space used for storage can be saved by using this process, and there is no doubt that considerable monetary savings are possible. However, there are several factors to be considered in the use of microfilm for records for retention purposes.

For one thing, there is still some doubt as to the acceptance of reproduced records as evidence in the courts. There is also the question as to whether or not they will have the persuasive or convincing effect which might be accorded the original papers themselves. The safest course to follow in this case would be to consult legal counsel first.

Another factor is the care that must be exercised in arranging and checking each file before it is put through the reproduction process. Since a record is greatly condensed in size when reproduced, the problem of locating a misfiled record is, in turn, magnified. Titles must be prepared which will clearly identify each file and the contents of each reel must be carefully catalogued so that the material may be readily located.

Conclusion

The logical solution to the records retention problem, therefore, would seem to favor a uniform policy and well-defined procedure based on the basic function of each record, the past experience of the department—particularly in legal actions—and the type and size of the organization. The initial work of establishing such a system is difficult, for it entails an analysis of each and every paper in use, and a decision on its retention period and ultimate disposition before that record is sent to the files. Once set up, however, the sound system should run itself, subject to only periodic review.

ACKNOWLEDGEMENT

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About the Author

DR. CLARENCE M. UPDEGRAFF was born at Dallas Center, Iowa, and received law degrees from the State University of Iowa, George Washington University and Harvard University. During a distinguished career which began in 1916 at Iowa City, he has served as educator at Louisiana State University, at George Washington University, State University of Iowa, and was a Teaching Fellow at Harvard Law School (1924-25). He also served as special assistant attorney general for the Iowa State Board of Education and was associate general counsel for the National Association of Manufacturers. He is a distinguished author and has occupied many important committee posts with American Bar Association and numerous legal societies.

Industry Backs Proposal To Curb FPC Powers

• CONTINUED FROM PAGE 38

been effected in the cost of natural gas to consumers. City gate rates subject to FPC have been reduced by some $41 million yearly. During this period the average retail price of natural gas has decreased about 10 percent, while the price of anthracite coal has risen 61 percent, bituminous coal 69 percent, and fuel oil, 79 percent.

On the other hand, industry sees a wholly different picture possible for the future due to new concepts of regulation now championed by FPC. Some of these are:

1. Commissioner Olds takes the position that anyone who sells natural gas into interstate commerce has "dedicated" his reserves to public utility service. Olds indicates that FPC could force the producer to do additional drilling so as to maintain an adequate supply for the public utility pipe line.

2. Many producers have written "escape" clauses into their contracts with interstate purchasers of natural gas, providing for cancellation in case FPC undertakes to regulate them. But Olds contends that such "escape" clauses are worthless because the producer, merely by the fact of entering into the contracts, has actually "dedicated" his gas reserves and cannot escape thereafter.

Major B. A. Hardey of Shreveport adduced proof that the proposed amendments to the natural gas act would not enrich the producers by showing that, of the average dollar spent by gas consumers in the country, only 9.1 cents goes to the producer, the rest to the transporter and distributor. Hardey pointed out that as to the consuming states supplied from the Southwest, the producer realizes only 4.6 cents of the consumer's dollar.

"Further," Hardey says, "the decrease in the price of natural gas to the consumer over the last ten years occurred in the absence of FPC control over the producing and gathering functions of the industry."

R. G. Lawton, Magnolia, Ark., vice-president and general manager of the McAlester Fuel Company, says that if FPC assumed control over the independent producers, the public interest would be impaired. "That," he explained, "would immediately and materially reduce the amount of gas moving in interstate commerce. In addition, the price of the gas would have to be increased to keep in operation the expensive pipe lines that have been built. This would necessarily be passed on to the consumer."

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This rapid disintegration of the bit cuttings permits greatly increased rates of penetration, often as high as 300 or 400 per cent over conventional type drag bits.

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Sands and sandy shales, formerly drilled with rock bits, are being drilled successfully at a faster rate of penetration with Reed Jet Bits.

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Replaceable tungsten carbide slush nozzles provide ample resistance to abrasion.

Unitized drop-forged bit blades with long reaming edges accurately dressed with "Reedite" inserts and granular "Reedite," mean full gauge hole all of the way down.

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Unitized drop-forged blades

•

Long reaming edge

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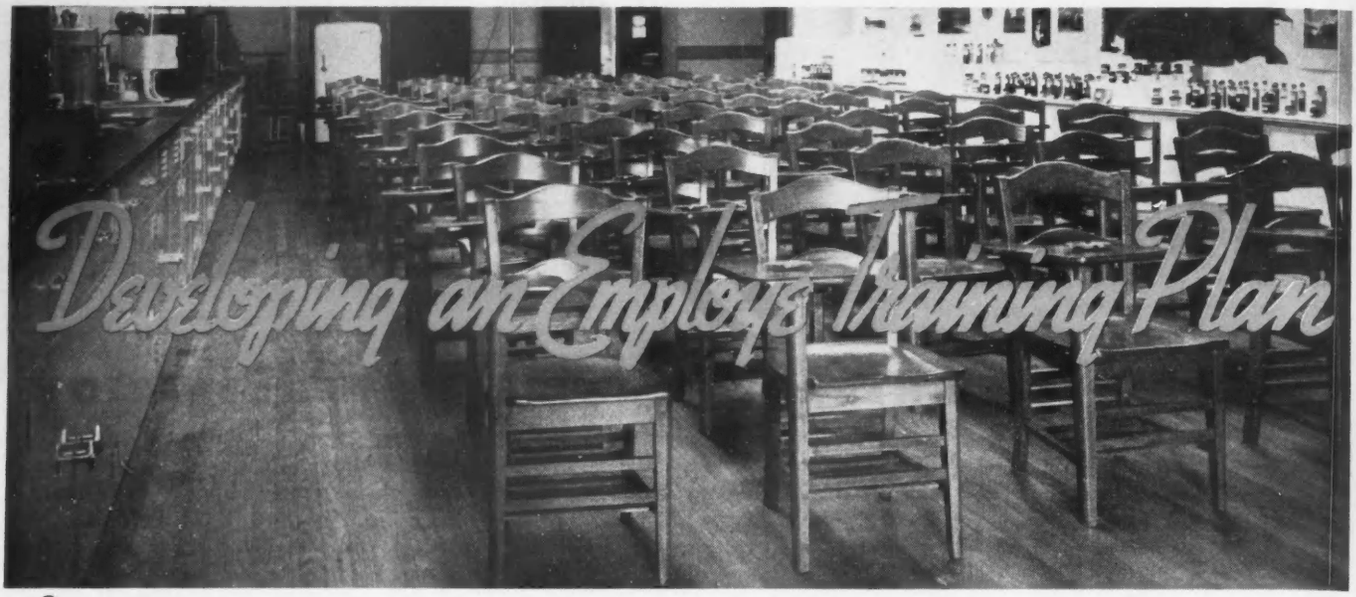
Extra-heavy hard facing on the blades for wear resistance

•

Proper reaming edge contour

- High-grade chrome molybdenum steels.
- All blades hard-surfaced and ground on centers for positive alignment.
- Improved welding techniques.
- Blades with strengthened molecular structures and toughened surface areas for strength and wear resistance.
- Correctly placed hard metal inserts.



Developing an Employe Training Plan

A view of the laboratory showing the laboratory bench on the left and the product display, featuring the industrial products, on the right.

By DENNIS V. WARD

Employe Relations Department, Standard Oil Company (N. J.)

THE training program which is described below is a product of more than 25 years of employe training experience of the Standard Oil Company (N. J.) group of companies. It is the outgrowth of policies which are regarded as having been a major factor in steady and mutually helpful employe relations.

There is no intent here to present it as an answer to all training questions. Indeed, the program here outlined comprises only a small section of the company's own training developments.

The aim, instead, is to set forth some lines of thought and practice in certain areas of employe training which have been found practical in this company's operations. As such, they may be useful as guides in the planning or evaluation of other programs for this type of training.

Although all the companies in the Jersey Standard group are directly concerned with petroleum, their activities differ widely. Some engage mainly in producing, others in transportation, manufacturing or research. Some market their products; others have nothing to sell and therefore need not train employes for consumer contacts. Some affiliates are large, some small; some are domestic, others operate only abroad. The domestic employes total more than 61,000.

Obviously, a training program to meet the needs of so comprehensive an enterprise would in itself have to be comprehensive. Yet no single training project alone, comprehensive or not, could hope to fulfill all personnel training functions across the board.

An important objective of this program, therefore, was to stimulate training farther along the line and to set standards for it. Another was to develop techniques and materials which might facilitate training wherever that was undertaken. It was understood that other training efforts had to take up where this effort left off, or that this training would start only where other efforts stopped.

GOOD EMPLOYER-EMPLOYE relations, necessary for maximum success of a company, depend in an important degree on the employe's chance to advance. Consequently, the principle of promotion from within the company underlies the employe training program here described. Of exceptional importance in an employe training program is the supervisor training phase. Today's foreman must be familiar with company policy, public relations, labor techniques, national labor trends, sociological trends, inter-relationship of departments of a company, and governmental relations and requirements. To qualify a foreman in all these lines, the training program for supervisors is thorough, comprehensive, and well-planned. Its purpose is to help supervisors solve the many and varied problems involved in managing employes.

Organization and Function

It is the purpose here to deal mostly with organization and function. Attention in considerable detail will be given to the supervisor training phase and to the conference leadership method of training because those aspects have been of exceptional importance in meeting the needs of this company. However, without taking time or space to examine them minutely, a few items of background may appropriately be mentioned at this point because they help to show the "why" of some of the principal features of the program, or reasons for its high rank among the most important activities of the company. The term "company" as used here means the group of companies which comprise Standard Oil Company (N. J.).

The first item—it was suggested at the outset of this article—is the importance of good employer-employe relations to maximum success of the enterprise. The company's own experience contains a wealth of evidence, for instance, testifying to the fact that good employer-employe relations depend in an important degree on the "chance to advance." Opinion surveys back up the company's own observations in that respect.

An interesting thing in that connection is that 90 percent of employes have

been continuously with the company since the day they were hired. Most of the company's top officials have risen from the ranks. The principle of "career employment," and "promotion from within," thus will be found to underlie this training program throughout.

As for history, training of personnel in special groups for many years had been common practice in this company. During the war, however, it became evident that peace would sharply increase the training load. Here is how the outlook shaped up at that time:

Needs of veterans were certain to be numerous and important. The great technological progress which had come about in the war years was to compel instruction in unfamiliar techniques. Years of unavoidable neglect in the training of young engineers, sales personnel and potential supervisors would have to be made up.

Furthermore, postwar operation promised to be a high-cost proposition. As such, it was to put an unprecedented premium on individual efficiency, or competence on the job. That was to apply all the way up the personnel ladder.

All these factors combined to bring about, in 1946, the establishment of the Esso Training Center, one of the most important developments in Jersey's history of employe education. It is to be emphasized, however, that this center represents only a small part of the total training effort; in fact, a very small part. Most of the training still is done in the local companies and plants.

Its establishment was not, moreover, quite so quick and easy a development as this rapid recital of facts might intimate. No blank check was given. Nobody got a free hand. It was necessary for the Employe Relations Department to map out in detail the project it had in mind.

Typical Conference Leadership class includes representatives from Egypt, South America and Canada. Standing in the rear is F. DeBernardis, Esso Training Center staff man in charge of Supervisory and Instructor Training.

What was to be done? How was it to be done? And, above all, why did it have to be done? All these questions had to be answered.

One point merits spotlighting here, for it was to govern the program in its entirety: The program did not mean taking away from local management a responsibility which rightfully belonged there, i.e., the training of their own personnel. The program was intended to augment —not to replace—the effort of the local training supervisor.

Physical Facilities

Physical facilities for the training developments here described include a three-story building at Elizabeth, N. J., equipped with auditorium, classroom, library, conference room, offices, film preview room and other aids. It is conveniently located as to two refineries, sales division, laboratories, transportation and hotel and restaurant accommodations.

Here the training program makes profitable use of large - size demonstration equipment and a wide variety of other visual supports. A life-size gasoline service station, for example, was installed to help the planning of dealer training. Teaching the mechanics of home heating equipment is aided by disassembly and study of an oil burner. Glass miniatures of refinery units allow trainees to see what goes on in refinery operations. Charts, posters, motion pictures and slide films are utilized wherever those may promote visual realization of difficult technical subjects and supplement highly oral instruction.

The training center personnel numbers 23 persons, including an administrative staff of eight, two editors, an artist and a man in charge of the Audio-Visual Aids and the Film Library.

Courses conducted and the duration in each case are as follows:

Conference Leadership	1 week
Industrial Sales	8 weeks
Advanced Industrial Sales	3 weeks
Sales Management	2 weeks
Basics of Supervision	2 weeks
Petroleum Marketing in U.S.A.	9 weeks
Public Relations	3 weeks
Training Institutes	1 to 4 weeks
Student Engineering Indoctrination	3 weeks

All of the above are full-time courses. Much training also takes place on the job, at the employe's own plant or location, instead of in a classroom. On-the-job training is administered by the par-

The Esso Training Center occupies the second and third floors of the building or a total of about 15,000 square feet. The private entrance is shown on the side of the building beside the private parking lot.

ticular unit whose personnel is being trained.

As previously noted, the work of the training center is intended to augment, not replace, the training responsibilities of the local management. Functioning in that manner, it furnishes an ideal solution to certain training problems; such, for example, as those encountered in industrial sales. When there are only a few such salesmen in a territorial division, to give basic training locally would mean wasteful duplication of effort.

The courses listed above entail attendance at classes at the center from 8:30 to 4:30 p.m. five days per week. In addition, part-time courses are conducted regularly after hours in petroleum engineering, chemical engineering and mechanical engineering, the last two being refresher courses, for employes working in the vicinity of the training center.

Training for supervision was only one of many courses in the above list. The company has found the need for effective supervision to be so great today, however, that it seems appropriate to single out this phase for attention in some detail in this place.

M. J. Rathbone, president of Esso Standard Oil Company, declared some time ago that "developing good foremen is a harder job than selecting the proper machinery, location of a factory, or picking out a line of products to manufacture. Training the foreman is not something to be turned over entirely to industrial relations experts," he said, "but a definite management responsibility."

As our company sees it, the supervisor in fact IS management. Generally he is anyone who directs the work of others. The various levels of supervision constitute management, the functions differing only in degree from one level to the next.

It is our belief that although the Employe Relations Department is a staff agency, the supervisor, being a line man, is the one who is actually responsible for employe relations. Others, too, might write the policy, but he is the one who really determines its effect. Top management is completely dependent upon him for that. Moreover, as the one who knows the thinking of the personnel, the supervisor is the one to provide assistance in the formulation of policy. If that premise is accepted, it must be agreed that his position is definitely the "key" post.

The old-time foremen's conference long has served a useful purpose and still does. It does not, however, offer a way in which the newly-created supervisor can be given the concentrated training which he ought to have before assuming his new duties. Merely naming Bill Smith a supervisor does not make him one. It is a big step from being an employe in the ranks to being a good supervisor. Helping him over that transition was one purpose of this supervisor training program.

To quote M. J. Rathbone further, "The old well-known responsibilities of a foreman for safety, quality, quantity, costs, etc., are not enough. Today's foremen must know company policy and public relations, they must be familiar with labor techniques, national labor trends, sociological trends and many other similar matters. . . . The complexities of most modern businesses demand that foremen know the inter-relationship of the various departmental functions and how their actions may affect other departments. They must know and observe many governmental relations and requirements. The only way a foreman can become sufficiently expert in all these lines, is through comprehensive, well-planned training programs."

Supervisor's Qualifications

Jersey believes that in order to measure up to that job, the supervisor is expected to be, have or do at least these five things:

1. Have complete and thorough knowledge of his authority and responsibilities.
2. Maintain quantity and quality production at minimum cost.
3. Be a good manager—plan his work effectively, budget time between men, materials and management, know how to delegate responsibility and when to assume authority.
4. Maintain good employe relations through knowing how to deal with understanding their capacities and personal characteristics and winning their respect and confidence, both new and old.
5. Be able to train workers to perform new operations demanded by rapidly changing conditions.

The above features, it is felt, represent basic skills and knowledge, and the supervisory training program is directed to the development of such fundamentals. It is not intended for the cultivation of technical skills and knowledge required for specific trades or occupations. Its purpose is to help supervisors solve the problems involved in managing employes.

Following are the specific and yet broad objectives which served as guides for development of the supervisor training plan:

1. To outline the fundamentals of supervision so as to provide a sound basis for individual improvement and development.
2. To improve the quality of leadership and ability to solve the problems of supervision.
3. To give each individual supervisor a new and broader viewpoint of the responsibilities of supervision.
4. To maintain good supervisor-worker relationships by training in the latest recommended techniques of dealing with personnel.
5. To give the supervisor an opportunity to check on the soundness of his ideas and methods and to receive the benefit of an exchange of ideas in planned conferences with other supervisors.
6. To re-emphasize the need for genuine interest and a sincere, impartial and human approach in dealing with the individual worker.
7. To maintain a close spirit of coop-

Typical class in "Basics of Supervision" includes supervisors from refineries, sales divisions, accounting offices and engineering. Standing in rear are F. DeBernardis and L. Holroyd, instructors.

eration and understanding among all levels of supervision, and increase good will and cooperation throughout the working force.

8. To promote pride in the department and to develop an appreciation of the inter-departmental relationships contributing to total production.
9. To give supervisors an opportunity to acquire information of immediate importance to their job.

The program is so set up as to provide training for each stage of a supervisor's development, to whatever degree is required by the individual. It has certain elements of standardization, because essential aspects of supervising workers are common to all supervisors, at all levels and in all departments. In addition, by avoiding duplication in the preparation of materials, it releases time and money for exploratory and creative work in the field of supervisory development.

Five main needs are recognized by the supervisor program. Those follow, with the course or courses which were developed to meet each one (see Figure 1):

1. Discovering and developing individuals with leadership ability—Leadership Training Course.
2. Keeping the supervisory force up-to-date and well informed—Conference Discussion Program.
3. Providing basic training and information for newly designated supervisors — Basics of Supervision Course.
4. Providing for the improvement of supervisors in service — Principles of Management Course, Modern Management Practices Course.
5. Preparing individuals with special ability for added responsibility—Executive Development Program.

Training The Supervisor

Additional mention may be made of the Basics of Supervision Course (Item 3, above) because this is the device for bridging the often neglected gap, noted earlier in this article, between working as a rank-and-file employe and assuming the duties of a supervisor. The course is intended to acquaint the newly-made supervisor with the main responsibilities which go with his new status, and fix his attention on the knowledge he will need in order to do the job expected of him. A list (from Page 5, "Supervisor Training") of topics for discussion is presented in Table 1, not to try to set up a specific course, but to suggest a few ideas which may serve as guides in determining the content of this phase of supervisory training.

Special mention may be appropriate, also, of the Executive Development Program (item 5, above). Under this program, employes who show from their performance that they are likely executive material are put through a continuous observing and screening process which produces a record of their special talents. They are assigned to different jobs in rotation, so as to develop their knowledge of the business and their capacity for greater responsibilities. New positions may be created as training jobs for this purpose. To supplement this program of internal development, they may be sent, at full pay, to a special three-month course in advanced management at Harvard University.

There the study program is divided about equally between these subjects: Administrative Practices; Business and the American Economy; Cost and Financial Administration; Production Management; Marketing Management, and Problems in Labor Relations.

Besides offering a concentrated course of study in appropriate subjects, this program gives to men of special promise what the Harvard Graduate School of Business Administration calls "the opportunity to think to the limit of their mental capacity, free of business exigencies and other distractions, . . . association with other selected men of a great variety of business backgrounds . . . (and) the stimulation of contacts with a faculty that, because of the very nature of the teaching methods used, must keep abreast and even ahead of business developments."

At the time this article was in preparation, 58 employes of this company and its affiliates had completed the Advanced Management course, and 11 were attending the then current course.

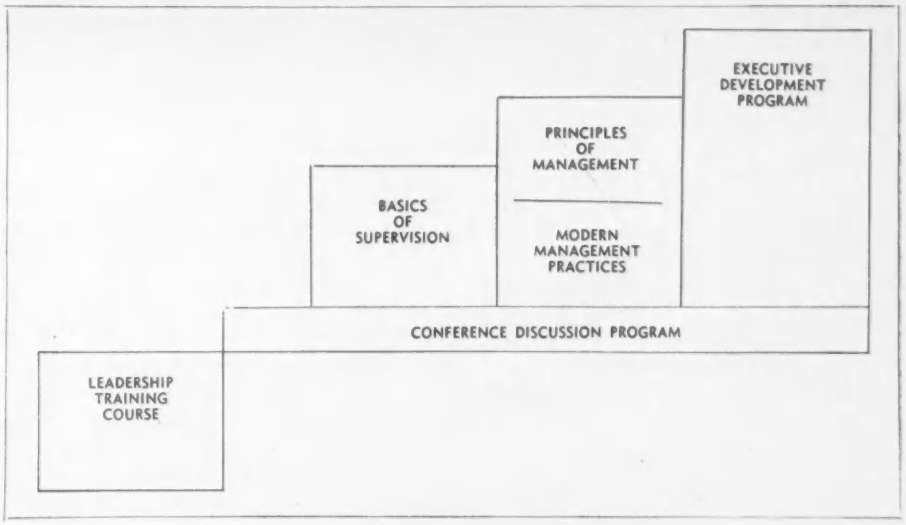


FIGURE 1. Esso Supervisor Training Plan.

TABLE 1
Basics of Supervision Course

(Page 5 of "Supervisor Training")

SUGGESTED TOPICS FOR DISCUSSION

A. The Coordinated Teamwork of Management
   1. Company and local organization
   2. Lines of authority and communication
   3. The needs for, and methods of accomplishing coordinated action—teamwork

B. The Supervisor's Place in the Organization
   1. Basis for selection—change of viewpoint
   2. Transition from worker to supervisor
   3. Responsibilities of a supervisor
   4. The tools of management and the services available to the supervisor

C. The Job of Supervision
   1. Dealing with people — how to handle human relations problems
   2. Training workers—The supervisor is an instructor
   3. Effective discipline—preventive vs. Corrective discipline
   4. Issuing orders and following up
   5. Budgeting time and action
   6. How to talk to workers
   7. Developing desirable attitudes
   8. Planning departmental meetings
   9. Starting the new man

D. Interpreting Company Policies
   1. History of employee relations
   2. Management-Union-Employee relations
   3. Grievance procedures
   4. Seniority
   5. Working schedules and overtime rules
   6. Employee rating
   7. Wage and salary administration
   8. Policy-vacation, accident, sickness, transfers, terminations, leaves of absence, hours and working conditions
   9. Dealing with the union representative
   10. Cost control

E. Safety for Supervisors
   1. Supervisor's responsibility for safety
   2. Safety supervision

Management's Role

One thing which experience with this program has impressed upon our company is that the success—or failure—of any plan for training supervisory personnel depends as much upon support by management as upon practicality of the information presented, competence of instructors and the numerous, component parts of a complete program. As we see it, management is responsible for these things:

1. Adopting a plan and announcing it in a clear-cut policy.
2. Providing training staffs of sufficient size and experience to make a quality program possible.
3. Providing adequate and appropriate facilities and material.
4. Designating qualified personnel to act as conference leaders.

5. Providing time for key management to participate.
6. Revising the program periodically for study of results.

The training supervisor directs and administers the plan, and under it he is held responsible for the following:

1. Preparing lists of and scheduling groups of supervisors.
2. Training conference leaders.
3. Determining most effective methods to use.
4. Preparing conference material.
5. Selecting visual aids.
6. Keeping records.
7. Followup.

Eligibility Factor

In Jersey, selection of personnel to attend training courses is considered a line function, and standards for selection a matter of local policy. However, a training plan is written for each course, and that plan takes up among other things the factor of "eligibility" for the guidance of local management in selecting candidates.

The method of instruction naturally will have a great deal to do with how successful a training program will be. Experience has convinced Jersey that the best method is that of the planned conference, for it enlists the thinking and participation of everyone in the group. Most supervisors have been found to be reluctant to "go to school." Many of them feel, perhaps, that much of such instruction has little to do with their particular jobs. They do, however, welcome the opportunity to "pool" experiences. They like to work out together the problems they face.

Most of the subject matter in the course falls within the personal experience of the supervisors themselves. Through discussion the individual gains the feeling that he has solved his own difficulties. In addition, he feels that he has contributed, from his personal experience, to the solution of common problems.

The conference method provides also a greater opportunity than other methods do for individual expression, aids in developing leadership qualities essential to the good supervisor, and is exceptionally effective for training in logical, constructive thinking. Conference leadership itself, therefore, is logically a course for supervisors. The individual learns to express his ideas and to develop good judgment and tact. Each of these is an essential quality for good supervision.

The course is a one-week or 35-hour, off-the-job program. Trainees are selected by local management and must be persons who will have direct responsibility for conducting conferences. Each group is limited to from 12 to 15 so that all can get in some real practice.

The first ten hours of the course are devoted to the principles and techniques of conference leadership. Here are some of the subjects for discussion:

1. Background of the conference method.
2. How it compares with other methods of instruction.
3. Duties of the leader.
4. Qualifications of the leader.
5. How to prepare for a conference.
6. How to conduct a conference.
7. Devices used.
8. Techniques of questioning.
9. Handling situations.

Conference discussion of such subjects leads up to a demonstration conference and to practice sessions for the remainder of the time. Each trainee has an opportunity to conduct three practice sessions.

One point that has been kept up toward the front in our training operations is that regardless of how interesting the program may be, trainees will not pay attention for long periods unless every step has been taken to make the physical conditions conducive to learning. For example, few things will kill interest faster than too much or too little heat in the conference room, stale air, too bright or too dim lighting, uncomfortable chairs or long-drawn-out sessions. Short breaks for relaxing are necessary at regular intervals.

What these points add up to is that trainees must be physically as well as mentally ready to learn.

Visual Aids

Visual aids play a major part in the program. Our experience has been that they are excellent for formulating correct concepts, for creating interest and intensifying impressions. They broaden experience, vitalize the program and save time.

This program uses them in the form of charts, photos, maps or overlays, blackboards, charting paper, and motion pictures and slides. When it is feasible, to these are added three-dimensional aids such as the object itself which is being discussed, cutaways or sections, models and sandtables.

But although visual aids have been found to be priceless tools for Jersey conference leaders, they accomplish little or nothing unless used correctly. The leader must be careful about number, orderly sequence and exact timing. The material must be pertinent, of a kind which permits smooth handling and must be clearly displayed.

In conclusion as to visual aids: Despite the allure of more spectacular devices, on the basis of experience in this program, too much can hardly be said in behalf of the old-fashioned blackboard. Some shy away from it on the claim that they can't draw. Others complain that they write too badly, or that it "takes time." But these are weak dodges. If careful attention is given in planning to the "what" and the "when" of using the blackboard, a good demonstration is certain. When it is used, alibis are out, for it is a one-man job.

Summary

To summarize very briefly some of the main impressions which have developed out of these training activities:

Although the needs for personnel training grow both in importance and in number, the techniques and materials for training are likewise numerous, effective and in process of further development. A program of centralized training can meet some major educational needs. However, by itself it is no solution to all employe training problems.

Training is best done not in a "schoolroom" but through the conference method. To "talk it out" is better than to try to "cram it down." However, best method though it may be, this one has been found a failure unless conference leaders are competent.

The supervisor has changed from the "boss" of years ago, to a leader who, on the one hand, must know much about company policy and industrial and sociological trends, and, on the other, must be able to pass along what he knows and how he feels to those whom he is selected to lead. Therefore, he must be trained as a leader, with all the care and thoroughness that are deserved by a key position.

Training is not something exclusively for the development of beginners or improvement of the skills of the relatively inexperienced. Some of the challenges to it, and opportunities for company benefits from it, are greatest at the management level.

Although numerous other observations might be made, only one last point will be added here and this one is offered not in any attempt to preach but solely because it seems to sum up a great deal of the cause for aggressive planning in this field and much of the hope that is held for it:

Employes are people and people—humans—make the company. Machines and buildings don't.

Naturally, this training program has en eye to commercial success, for without that there would be but slight satisfaction of human desires. But unless the will to solve the human problems that mark modern industry is in the forefront of the purposes and practices of the training program, the net results when translated into terms of the balance sheet are likely to leave much to be desired.

Baash-Ross News

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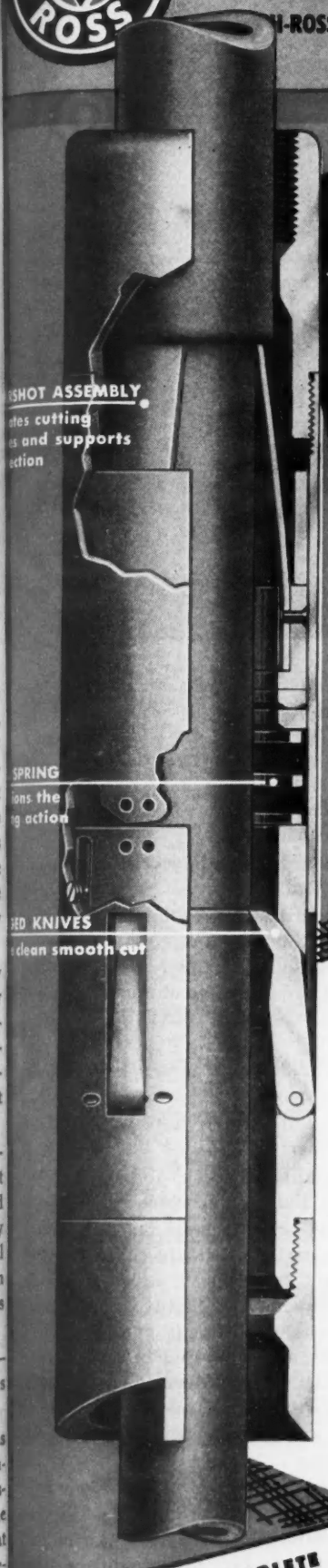

TO CUT REGULAR PIPE

As illustrated at left, for cutting Regular Pipe the tool is made up with Overshot Springs that catch under a tool joint or coupling to both actuate the cutting knives and then retain the cut-off section for recovery after cutting. (Note that the cut section is not supported by knives alone.)

TO CUT UPSET PIPE

As illustrated at right, the same basic tool is used to cut Upset Pipe by simply substituting a special assembly with "Dogs" that catch on the taper of the upset to both actuate the cutting knives and also retain the cut-off section for recovery on the same trip. (Note again that knives alone are not used to support the cut section.)

TO CUT FLUSH PIPE

As illustrated at right, the same basic tool is also used to cut Flush Pipe by simply substituting a special Slip Assembly that grips the pipe at any desired point to both actuate the cutting knives and retain the cut-off section for immediate recovery. (Here, too, knives alone are not depended upon to support the cut section.)

Change from one type of design to another can be made quickly and easily—even in the field—by simply removing the top sub, withdrawing the assembly and spacer in use, and then replacing with the new assembly and spacer desired.

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Functions of an Automotive Transportation Department

By J. D. WARD
Automotive Department, Tide Water Associated Oil Company

OIL companies, both large and small, have millions of dollars invested in automotive equipment ranging from small cars to fleets of heavy trucks, all of which play a vital role in all phases of the petroleum industry. It is therefore essential that some set policy be followed in the management and maintenance of this equipment. At the same time the policy should be flexible enough to tie into a company's over-all operations and to assure maximum efficiency and economy in the Transport department.

Recently, the question was posed as to whether an oil company should maintain a Transportation department, or whether there should be divided authority and loose control. The author submitted the question to a select few of the top-flight transportation executives in the oil industry in an attempt to secure the benefit of their views and their experience. In order to clarify the issue the executives were asked to give their opinions on two principal phases:

1. Should an oil company centralize all control and management of vehicles and transportation in a single department which would have the authority to buy, maintain and assign the units?

2. Should an oil company eliminate all its passenger and small truck units and meet its need for such equipment by entering into a fleet rental arrangement?

Opinions definitely favored centralized control and management, and the reasons advanced by two ranking oil company transportation executives in the Mid-Continent area are presented herewith as a sort of "blue print" which may assist oil companies generally to determine the functions and polices of their transport departments.

IT IS ESSENTIAL to an oil company that a definite policy be followed in the management and maintenance of its automotive transportation equipment. The policy should be well defined but sufficiently flexible to mesh smoothly with all company operations and to assure maximum efficiency and economy in the transportation activities. Opinions of several oil industry transportation executives definitely favor centralization of all control and management of vehicles and transportation in a single department, which would have the authority to buy, maintain, and assign the units. Suggestions of two transportation executives are herewith presented as an aid in determining the functions and policies of a transportation department.

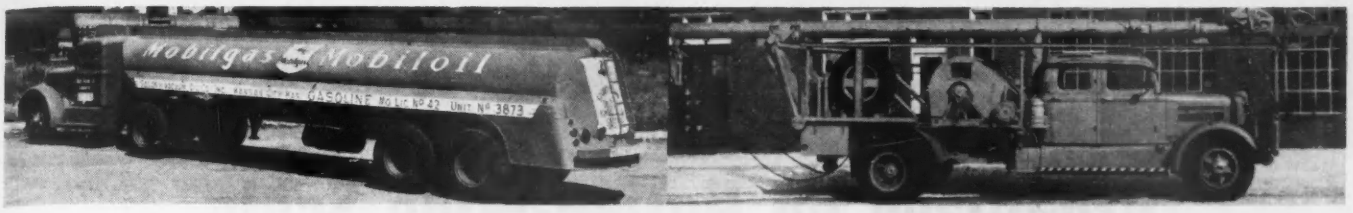
One executive favored centralized management because it provides control in the following functions:

1. Approval for only those repairs which are necessary.
2. Discounts on points for purchase of tires and tubes, batteries, etc. for fleet billing.
3. Standardization on accessories for cars and trucks.
4. Standardization on classification of cars and trucks.
5. Standardization on method of disposing of cars and trucks (by age or mileage). In this respect records should disclose condition of equipment when considered for replacement.
6. Standardization on truck and special equipment.
7. Discounts on purchase of materials and parts.
8. Job-rating of trucks for work to be done and area in which used.

This executive declared that the Automotive department should control interdepartment transfers or assignments of idle equipment. Also that it should function as one department specialized in purchasing and disposing of equipment. He mentioned that departmental overhead and insurance should be distributed over all company-owned units and all rental units.

As for the rental proposition, this executive declared:

"Car rentals usually revert to a larger car at a higher rate than would be furnished if company owned. Car rentals usually want only the high mileage units and those in highway work, which increases the cost of company-owned units operating low mileage or those in severe



These, and many other types of automotive equipment, representing millions of dollars, are operated by the oil industry. They play a vital role in all phases of oil exploration, development, marketing and refining.

operations where operating cost is higher."

Another executive pointed out that much can be said in favor of good fleet management and that ofttimes there is an inclination to the mistaken idea that vehicles can be kept running simply by keeping them filled with oil and gas. In this executive's opinion the operation of a good motor transportation department demands that:

1. The department should be headed by a good fleet manager, preferably an automotive engineer, with practical experience in design, fabrication and field operating, and maintenance of transportation equipment. Sufficient clerical help for cost control and routine work is also essential. Field staffs and garage personnel naturally depend on the size of the fleet and how widely it is scattered.

2. Budget control of capital funds for the purchase of transportation equipment should be vested in the Motor Transport department. Expenditure of these funds should be the joint responsibility of the Motor Transport and Operating departments.

3. Specification, make, size, etc., of all motor equipment purchased is the responsibility of the Motor Transport department.

4. Since most companies maintain Purchasing departments, there seems no point in duplications; therefore, the Purchasing department should buy vehicles on approval requisitions and according to specifications furnished. The Motor Transport department should lend assistance in the procurement of such vehicles or equipment.

5. Assignment of vehicles to operating departments should be on approval of the department manager and concurred in by the Motor Transport manager.

6. The control of assigned vehicles is the responsibility of the operating departments.

7. The Motor Transport department should act as a service group in all maintenance of such vehicles, and any expenditure for such should be concurred in by the operating department supervisors.

8. All historical data, purchase, costs, replacements, etc. should be accumulated by the Motor Transport department. Monthly or quarterly cost statements should be furnished by Motor Transport to Management and all operating managers.

Replacing Vehicles

9. As the economic life of a vehicle is reached, the Motor Transport department should recommend rehabilitation or replacement of the vehicle. Such decisions should be predicated on accepted formula, cost records, historical data, etc., used in good fleet management.

10. All vehicles that have been replaced due to economic life attainment or mechanical failure, after cursory examination, should be disposed of through regular salvage channels with the concurrence of the Motor Transport department manager.

In effect, a Motor Transport department should be able at a moment's notice to supply safe and adequate transportation for all operating departments. In order to achieve its objective it must be independent of all other departments.

In indorsing the establishment of an automotive department and outlining its functions, another executive analyzed the situation of a large oil company and submitted the following reasons why the company should establish a separate Automotive Transport department.

1. On a conservative basis, Company "A" has an investment of over $1 million in automotive equipment.

2. The company's vehicles operate a total of 5 million miles annually of which passenger cars, pickups and light trucks account for 4 million. On an accepted basis of one-half cent per mile as the profit of the average rent-a-car company, the 4 million miles covered by these light units represent $20,000 per year, sufficient to set up and maintain a very sizeable transportation department for one year.

3. Company "A" has a total of 450 units and spends in the neighborhood of $350,000 per year for maintenance, gas, oil, grease and operating expenses. The disbursement of this sum is now divided between operating heads, operators, etc., very few of whom know little about the actual mechanics of mobile equipment.

In order for company "A" to set up and operate an efficient Automotive Transportation department, it should:

1. Employ a competent automotive manager.

2. Give him full control and allow him to employ one or two traveling mechanics or supervisors. Set up company owned automotive shops where there is a large enough concentration of automotive equipment to justify.

3. Work out and set up a full preventative maintenance service on all equipment. This one item alone will pay the cost of transportation department in preventing "down time" which cannot be shown on any cost statement.

This company can reduce costs by at least 1 cent per mile; can secure better trade in values on old equipment; can reduce number of miles now being driven; and in all probability can substantially reduce the number of pieces of automotive equipment as well as cut "down time" lost while equipment is down for repairs.

About the Author

J. D. WARD became interested in traffic management and transportation problems in 1929 and today is considered an expert in this specialized work. He was born in Stamps, Ark., where he attended the Stamps High School and later moved to Tulsa to attend business college. His first oil company job was with Altitude Petroleum Corporation in 1932. Two years later he joined Skelly Oil Company's Automotive-Traffic department and in 1936 took charge of Tide Water Associated Oil Company's newly-organized Automotive department.

Industry's Communications

Organized on Nation-Wide Scale

By J. E. KASTROP, Staff Writer

THE petroleum industry has a new permanent organization to facilitate frequency allocations among its five recognized branches that require radio communications for its operations. It is called the National Petroleum Radio Coordinating Association, and is composed of representative members of the refining, gas pipe line, geophysical, oil and products pipe line, and production branches of the industry. This new communications organization will aid in the administration of new changes in Federal Communications Commission Rules and Regulations which go into effect July 1, 1949, and which apply to the petroleum industry. These changes are the results of a new approach to the mounting difficulties which have arisen from the tremendous growth of radio communications, not only in the oil industry, but in other industries as well. It is a move to let the industry solve its own radio communication problems.

The U. S. has been split up into seven regions to cope with problems on an "area basis." The national organization is headed by a 12-man executive committee composed of the chairmen from each region plus one representative from each of the five branches concerned with the new changes. Each region was organized to include a chairman, vice chairman and a secretary, plus various committee chairman in the regional organization.

In May, 1948, the FCC proposed drastic changes in Part 11 of its Rules and Regulations which would affect the power utilities and the oil industry. Both groups consented to organize temporary coordinating committees to study the proposed changes and the effect they would have on each industry. The oil industry's temporary committee drafted objections to the proposed rule changes and these objections were presented to the FCC at a formal hearing. The five branches were represented as were the American Petroleum Institute, the Petroleum Industry Electric Association and the American Gas Association.

At the hearing, technical information and recommendations were presented, and the FCC agreed to adopt the changes recommended by the oil group. On May 16, 1949, a representative delegation of all areas and branches of the industry met in Washington to set up a temporary National Petroleum Radio Frequency Coordinating Committee. This committee met informally with the FCC which approved the proceedings, whereby the U. S. was divided into seven regional areas and temporary chairmen were appointed to each region. The temporary chairman were instructed to organize a permanent Regional Petroleum Radio Frequency Coordinating Association within each region and to invite all radio users and prospective users to participate.

Each regional group made an intensive study of oil industry radio communications within its respective region, and made recommendations for frequency allocation within the industry for its area. A nation-wide meeting was held in Kansas City, June 13-15, 1949, at which time the permanent 12-member executive committee was elected. H. A. Rhodes, Humble Oil & Refining Company, Houston, was elected national chairman of the executive committee, and was also selected to represent the oil and products pipe line branch. Warren T. Bulla, elected vice chairman, represents the gas pipe lines and is also a member of the AGA Radio Communications Committee. Secretary-treasurer is W. G. McLarry, Magnolia Petroleum Company, who represents the refining branch. Other oil industry branch representatives are: production, O. B. Hocker, The Texas Company; and geophysical, Dr. Ralph D. Wycoff, Gulf Research & Development Company.

Regional Chairmen

Regional chairmen are: Region 1, W. A. Shipman, United Fuel Gas Company, Charleston, West Va.; Region 2, J. D. McCullough, Buckeye Pipe Line Company, Lima, O.; Region 3, L. C. Bomar, Southern Natural Gas Company, Birmingham, Ala.; Region 4, R. S. Caplan, Gulf Refining Company, Houston; Region 5, E. E. Born, Phillips Petroleum Company, Bartlesville, Okla.; Region 6, K. S. Hagius, Colorado Interstate Gas Company, Colorado Springs, Colo.; and Region 7, J. A. Polhemus, Jr., Standard Oil Company of California, San Francisco. Each regional chairman is also chariman of the frequency coordinating committee within the regional group to handle radio communication matters of the oil industry that arise within the region.

Section 11.57 of the new rules and regulations pertaining to the policy governing the assignment of frequencies to the various users of radio communications within the oil industry read as follows:

Paragraph (a): "The frequency which may be assigned to stations operating in any one of the several Industrial Radio Services is listed in the applicable subpart of this part. All applicants for, and licensees of, stations in these services shall cooperate in the selection and use of the frequencies assigned in order to minimize interference and thereby obtain the most effective use of the authorized facilities. Each frequency, or band of frequencies, available for assignment to stations in these services is available on a shared basis only, and will not be assigned for the exclusive use of any one applicant; such use may also be restricted to one or more specified geographical areas."

Paragraph (b): "Each applicant shall use the highest order of frequencies available, compatible with the operational requirements of the particular radio system involved, and the actual channel loading of the bands in each area. Differentials in first costs and maintenance expense are factors which will not be considered as conclusive by the Commission in approving a choice between the ranges 1.6-6.0, 25-50, 152-174, and 450-460 megacycles."

Paragraph (c): "Each application for authority to operate on one of the frequencies in the range of 1.6-6.0 mc. must

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The seven regional divisions of the National Petroleum Radio Coordinating Association.

be fully justified, and shall be accompanied by: A satisfactory showing that the safety of human life will be jeopardized by failure of the Commission to authorize the use of a frequency in the requested range; a description in detail of the particular activity involved; and the manner in which radio will be used in the activity. The circumstances must be such that the activity, by reason of its nature or location, is hazardous to personnel engaged in the activity, or to the public in the vicinity thereof; that the radio communication facilities requested will materially reduce such hazard; and that it is impossible to use a higher order of frequencies for accomplishment of the same purpose."

The following frequencies were assigned exclusively to the petroleum radio service for base and mobile stations:

Megacycles	Megacycles	Megacycles
25.02	33.26	48.82
25.06	33.30	48.86
25.10	33.34	48.90
25.14	33.38	48.94
25.18	48.58	48.98
25.22	48.62	49.02
25.26	48.66	49.06
25.30	48.70	49.10
33.18	48.74	49.14
33.22	48.78	49.18

The following frequencies are available for base and mobile stations on a shared basis with other services:

Kilocycles	Megacycles	Megacycles
1602	30.66	153.17
1628	30.70	153.23
1652	30.74	153.29
1676	30.78	153.35
1700	30.82	158.31
2292	153.05	158.37
4637.5	153.11	158.43

In addition to these frequencies, certain frequencies about 456 megacycles were available on a developmental basis, as are frequencies which are still higher. Subject to the conditions that no harmful interference will be caused to the reception of television channels 4 and 5, frequencies from 72.02-75.98 megacycles will be available to the petroleum industry on a shared basis with other services.

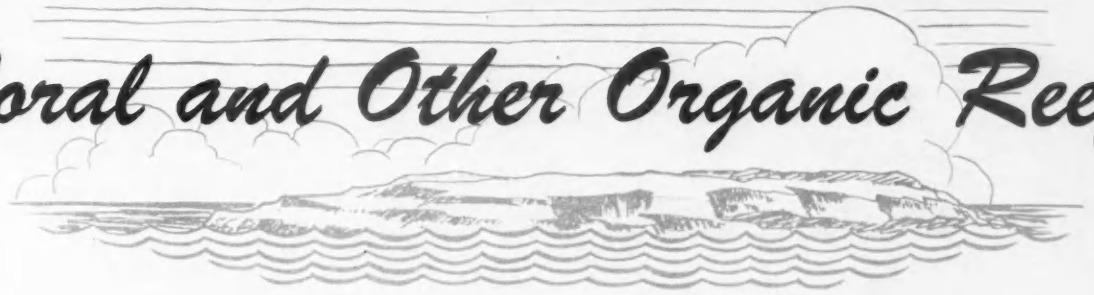
The geophysical branch has the exclusive use of frequencies from 25.02-25.18 megacycles, and may share with other branches frequencies from 25.22-25.30 megacycles. Frequencies from 33.18-49.18 megacycles, are shared by the remaining four branches of the industry. Frequencies from 1602-1700 kilocycles are used only in the petroleum industry by the geophysicists, although other services outside the industry use them. Peculiar characteristics of geophysical operations made this allocation necessary. The frequencies 2292 and 4637.5 kc are shared by geophysics with other industry branches on an emergency basis.

In the event a user's license expires, he makes application for additional or modification of services, or FCC revokes his present license, the following procedure must be followed: The user makes a license application accompanied by a letter explaining the proposed use of his system and stating his preference of frequency, and sends them to the chairman of his region. The regional chairman and the radio frequency coordinating committee study the application as it affects the local communications situation. Recommendations and approvals by the regional group are returned to the user, who forwards them with his application to the FCC in Washington, D. C.

Success of the present radio communications organization as it affects the oil industry is due in large part to the efforts of W. F. (Bill) Littell, Interstate Petroleum Communications, Inc., who is also chairman of the API Central Committee on Radio Communications, and to those who actively participated in the pre-organizational meetings and formal FCC hearings.

Characteristics and Geologic Distribution of

Coral and Other Organic Reefs



By
W. H. TWENHOFEL

THE word reef has many meanings, but to the geologist it is associated with the mounds or ridges built on a sea bottom by corals, algae, sponges and a few other organisms.

Although most reefs are built in the sea, algae can build reefs on the bottom of a lake or a stream. A reef represents a deposit that is mainly of organic origin and has been built upward at a more rapid rate than the contemporaneous sediments deposited about its margins. It ordinarily is thought of as a ridge of great length and limited width, rising somewhat like a wall on the seaward side and bordered by a lagoon on the landward side, and either in the form of a fringe adjacent to the land or a considerable number of miles from shore in the form of a barrier.

Although this general concept applies to many modern reefs as illustrated by the reefs of the East and West Indies, it is not particularly applicable to most reefs in the geologic column prior to the Permian. The ancient reefs were mostly in the form of isolated ridges or mounds on somewhat limited dimension. The ridges and mounds, however, have a somewhat linear distribution as is illustrated by the Silurian reefs that lie around the Michigan Basin of the U. S. Only in the Permian do the Paleozoic reefs have elongation somewhat similar to that of modern reefs and some of the Permian reefs seem to have been of the barrier type.

Doctors E. R. Cumings and R. R. Shrock (1928, 1932), both then in the University of Indiana, proposed the two terms of bioherm and biostrome, the former to apply to those organic accumulations which have the conventional form and internal structure of a reef and the latter to stratified organic accumulations which are not in the form of mounds or ridges and do not have noteworthy differences in thickness from margining accumulations. Many of the organic accumulations in the geologic column to which the term reef has been applied are really biostromes and have been termed reefs because of containing many corals.

Organic reefs seem to form largely in shallow waters, not deeper than about 50 fathoms. Algae are limited to depths to which light can penetrate to make chlorophyll and modern reef-building corals are limited to depths that are less than 50 fathoms. Sponges, crinoids and some other organisms may make organic accumulations at greater depths than the above figure and these may build up the bottom to the depths where algae and corals can take over. Once established, the reef-building organisms build upward very rapidly to the surface of the water where upward growth due to organic activity ceases. Growth may continue laterally. Waves may cover a reef with sand or other sediments and build the summit above sea level and winds may drift sand to raise it to a higher elevation. If seal level should rise during the building of the reef or after it had been built to the surface of the water, the organisms could continue building toward the new surface.

Generally speaking, a reef is composed of a core and flanking stratified sediments which are inclined away from the core. The core is really the reef. The core is without stratification and is an irregular and complex mass of organic materials made by many kinds of organisms. The flanking sediments have rude stratification adjacent to the core with which there is irregular contact. Flanking the core on the seaward side is the fore reef, which is a kind of sub-aqueous talus slope in that the composing materials are largely debris that have been eroded from the core, but some of them have been derived from organisms living on the forereef and some sediments were derived from organic and terrigenous materials settling from overlying waters.

The sediments composing the forereef are largely calcareous and initially were composed of sand-size and larger particles. The deposits are in thick beds adjacent to the core and beds thicken and thin irregularly. These pass outward into regularly bedded sediments which in most cases were originally lime muds. The stratified sediments of the forereef and the structureless materials of the core interfinger irregularly as shown in Figure 1.

The backreef is on the landward side. This is ordinarily composed of finer materials than the forereef and in large part consists of calcareous muds. Sand-size particles may lie adjacent to the core. The core commonly does not rise so high about the bottom on the landward as on the seaward side where there may be a difference of elevation between the top of the reef and the adjacent bottom of a good many feet. The lagoonal sediments interfinger irregularly with the structureless materials of the core just as on the seaward side of the reef. The outer margins of the core have contacts with the stratified marginal sediments that range from horizontal to far beyond the vertical. The contacts at any place tend to be sharp and it seems obvious that the exoskeletons and precipitates of the building organisms were adherent to the underlying materials at the times of deposition.

After a reef has been built to the surface of the water it may be extended laterally over the margining sediments with the greatest extensions on the seaward side, as that would be likely to be

EXPLORATION for oil in the U. S. and Canada henceforth will place much emphasis on the finding and development of oil-bearing reefs. This article, written exclusively for WORLD OIL, describes reefs, explains how they were formed, points out their varying forms and characteristics, and states that reefs may be expected in each geologic section that offers favorable environment for reef building. Reefs should be sought especially in every great calcareous formation, according to the article, and reefs of particular interest to the petroleum industry include those in the Ordovician, Silurian, Devonian, Mississippian and Permian, while reefs may be expected also in the Pennsylvanian and other sections.

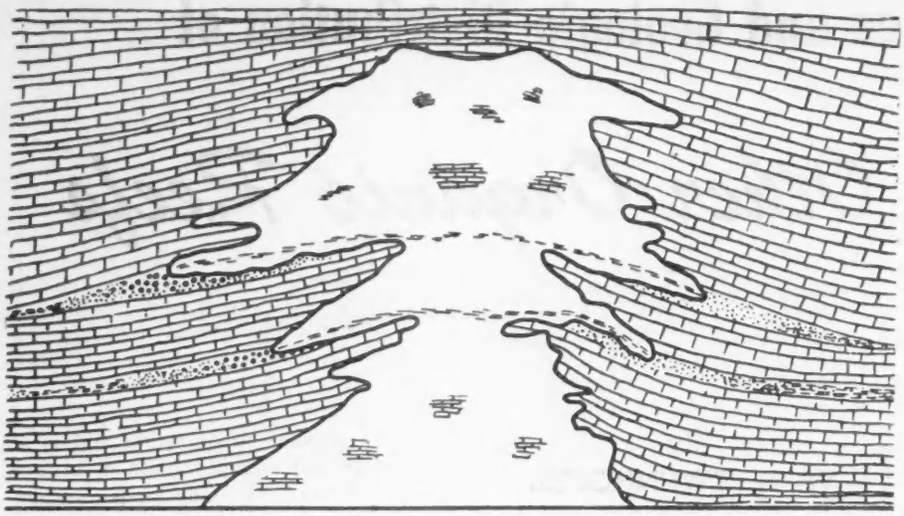


FIGURE 1. Diagram showing relations of an organic reef and the marginal strata. Stratification should be indicated as rude on the immediate margin of the core. Stratigraphic breaks may exist at the places of extensive lateral spread and this is supported by the sandy zones at the same level. Diagram based on studies of the reefs of Anticosti, Gotland, and eastern Wisconsin.

the side with the greater aeration of waters and the greater content of food in the waters. Lateral extensions may also be built at any stage in the upward growth of the core, as there is intense competition of the reef-building organisms for food and they would build their constructions most extensive in the directions from which the food came.

The strata margining the core are inclined away therefrom at angles that range to 30 or more degrees and inclinations of 65 degrees have been reported. Inclinations are ordinarily greater in the forereef than the backreef. The stratified sediments drape around the core like a shawl, and if reef building should come to an end and the core should become covered with sediments, these would have the form of a dome or anticline which would be extended upward until the marginal strata had been built to about the same level as the strata over the core. As the marginal strata in large part are composed of lime muds and subject to compaction as other sediments are deposited over them and the core and overlying strata are comparatively rigid, the domal or anticlinal structure might be extended upward for hundreds of feet.

The organisms that construct or add to the accumulations that form the core of a reef are of two kinds, of which one builds the framework of the core and the other fills the spaces within the framework. Organisms of the first class are the colonial corals, algae and sponges, some crinoids, and a few other groups. The colonial organisms plaster themselves over each other to form what initially is a rather strong and rigid framework, which functions in the core somewhat as the steel frame in a large building. The other class of organisms lives in the spaces between the structures built by the colonial organisms. These consist of non-colonial algae, corals and sponges, and mollusks, brachiopods, bryozoans, and foraminifera. The exoskeletal and other matter of these organisms and sediments washed from the colonial organisms and present in overlying waters fill the spaces with sediments, but other spaces are created as the colonial organisms build upward.

Reefs are places of strongly intensive and competitive activity. The dead and living organic matter in a reef is food for many organisms that throng it, and after the colonial and other structures are abandoned by their builders, they are bored into by organisms that acquire food in this way or bore into the reef materials for protection from enemies. These borings may penetrate a reef in all directions as it is built upward, and even before some structures are abandoned by their builders they may be perforated with the holes of boring animals. The work may be so completely done that the materials of the inner part of a reef may be reduced to fragments and the reef may become like a piece of wood that has been riddled by termites.

Initial porosity of the materials of the core of a reef may be large. Corals have empty spaces between their tabulae; algae have interlamellar spaces; there are empty spaces between the diaphragms of bryozoans; and shells have empty space in the deserted chambers of cephalopods, in the coils of gastropods, and between the valves of pelecypods and brachiopods. The space thus more or less sealed off from the outside may exceed 50 percent of the volume. Paleozoic corals like *Favosites* may have space sealed off by tabulae so that they will float in water and it is known that some modern corals float when torn loose from places of attachment. Porosity may be very high, but permeability very low. After boring organisms have penetrated the core and riddled the framework, porosity may be decreased as the original spaces have been largely destroyed, but permeability is likely to have been increased. As the waters permeating a reef may contain much calcium carbonate, magnesium carbonate, or silica, some of the dissolved substances may be deposited in the reef materials to decrease both porosity and permeability. In the other hand, the permeating waters may be charged with carbon dioxide derived from decaying organic matter and some of the reef materials may be dissolved and both porosity and permeability be increased.

The organic fragments bordering the

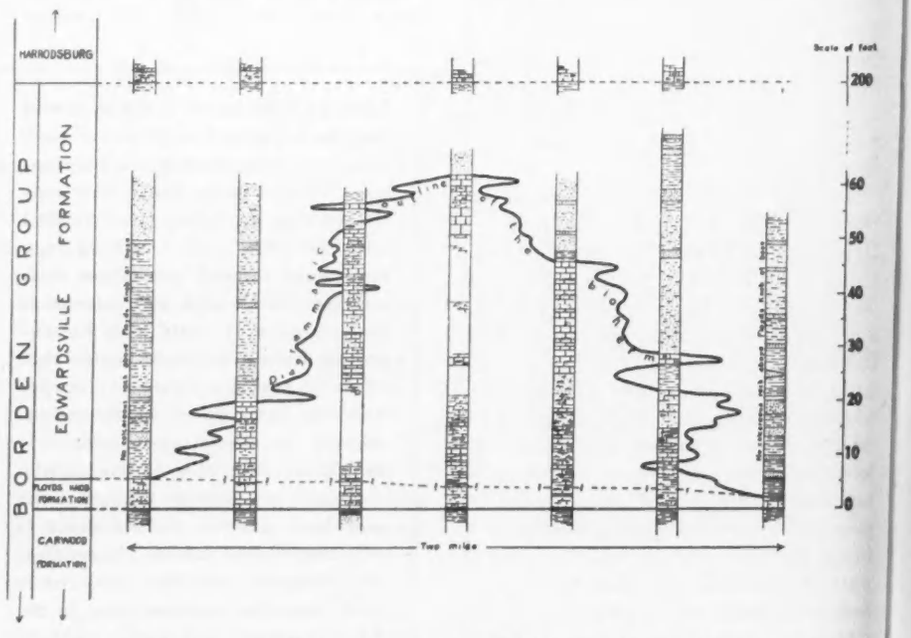
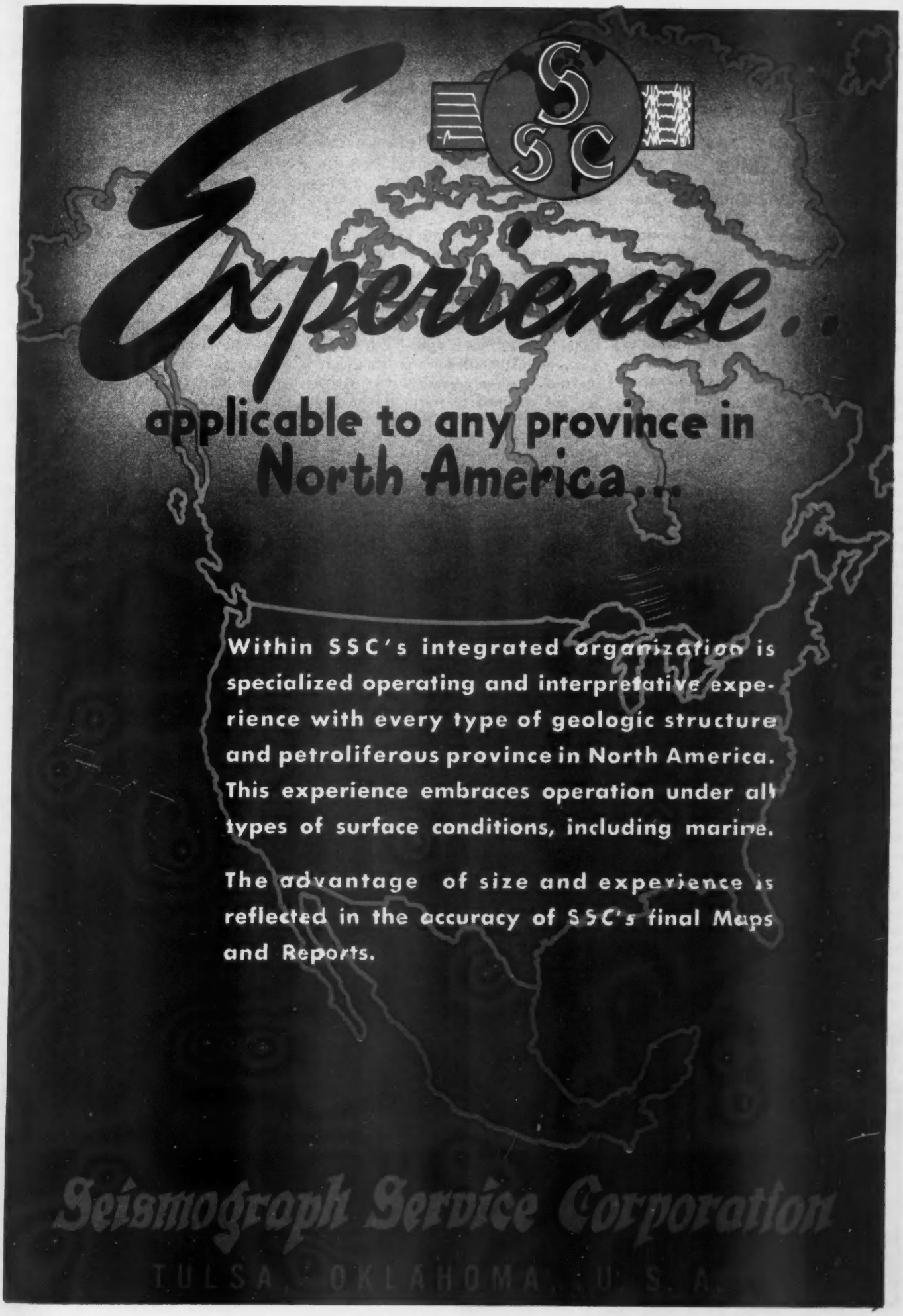


FIGURE 2. Bioherm built by crinoids. Marginal strata are shale as shown in columns on the side. Diagram after Stockdale, Bull. Geol. Soc. Am., Vol. 41, 1930.

July 1,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core of a reef, if of sand or larger size, may have considerable initial porosity and permeability and these may be increased or decreased by permeation waters, either removing something by leaching or depositing something from solution.

After reef building has come to an end by rise of sea level or some other cause, deposition may continue over a reef and the adjacent bottom. The sediments deposited over the summit of a reef are on a higher part of the bottom than those deposited over areas marginal to the summit. The former are thus subject to greater agitation of the water than the sediments on lower positions with the result that the finer sediments are removed from the summit and washed to the lower positions so that the sediments that remain on the summits are coarser than the marginal sediments. This makes for greater initial porosity and permeability in the strata over the tops of reefs than is present in the margining sediments. As the margining sediments are fine-grained they are subject to compaction as the sediments accumulate, whereas the reef and the overlying sediments are relatively rigid so that initial porosity and permeability are little reduced over the summits by reason of compaction. Cementation resulting from deposition of materials from solution in permeating waters may decrease both porosity and permeability, and leaching by these waters may increase both.

Diagenetic processes are likely to affect reefs and marginal and overlying sediments. Aragonite is almost certain to change to calcite; calcite may be replaced by dolomite with increase or decrease in volume depending on how it is done. Either calcite or dolomite may be replaced by chert or flint. The core of a reef and marginal and overlying sediments may become re-crystallized so as to destroy fossils and original characters of sediments and produce a coarse-grained limestone. That these things take place is proven by numerous reefs in the geologic column. The diagenetic processes affect both porosity and permeability, in some cases decreasing both, in others increasing them.

It is thus obvious that core materials and marginal and overlying sediments have initial porosity and permeability, but that boring organisms, cementation, leaching, and diagenetic processes are likely to change initial porosity and permeability, in some cases increasing, in others decreasing them. Permeability is likely to be increased by boring organisms, leaching and some diagenetic processes. On the other hand, deposition from solution, re-crystallization and other diagenetic processes tend to decrease permeability. The extent of changes that have taken place in a buried reef can not be forecast in advance of drilling.

Corals that build reefs at the present time require a minimum temperature that is rarely lower than about 68° F. It is not known what was the lower limiting temperature of the extinct reef-building corals, but it seems likely that it was not greatly different from that limiting their modern representatives. Algae are not confined to warm waters and they now build large accumulations in the North Atlantic in waters with temperatures that are little above freezing. It is not unlikely that such was always the case.

Recrystallized Reefs

Many ancient reefs are completely re-crystallized and many are not only re-crystallized but also completely dolomitized. It is not known why this is the case. For instance, the Silurian reefs of Wisconsin, Indiana and some neighboring states are rather completely dolomitized and in some cases are almost barren of fossils. The Silurian reefs of Anticosti Island in the Gulf of St. Lawrence are not greatly changed from original conditions. Some of the Silurian reefs of Gotland in the Baltic Sea are little changed; those on the Russian side of the Baltic Sea in Esthonia are rather completely re-crystallized. The boring on the Island of Funafuti in the Pacific found the reef materials dolomitized from 748 feet to the total depth of 1114 feet. The boring on Bikini Atoll in the Marshall Islands to the extent the samples had been studied in early 1940 (Ladd and Tracy)* showed no dolomitization. The reasons for these differences are not known.

*An extensive bibliography related to fossil corals reefs is given by the writer in a forthcoming paper to be published by the American Association of Petroleum Geologists.

The organic structures known as reefs have been built somewhere in every geologic period since the beginning of the Huronian, and it seems likely that reefs were also built in Pre-Huronian times. The organisms playing the major roles have changed with the periods, but since the appearance of each phylum that had reef builders, some members of the phylum have contributed to reef formation in every succeeding period. The places of reef building have changed with the positions of the seas, and reefs may be expected in the geologic sections of each system where the evidence suggests that environmental conditions were favorable for reef building organisms. Occurrences in the sub-surface are probably more abundant than in the surface exposures of formations, as the sub-surface distribution of rocks of most of the systems is greater than the surface distribution. This is particularly true of the rocks of the older systems. Reefs should be sought in every great calcareous formation.

Pre-Cambrian reefs were built by algae, and those of the Cambrian by algae and primitive sponges. In general, these systems have little interest for petroleum geologists. Corals became reef builders in the Ordovician and aided the algae and sponges in forming reefs, but did not have great importance in the early part of the period. Corals and algae had a great role in building Silurian and Devonian reefs. The climax of reef building by corals in the Paleozoic probably came in the Silurian. Crinoids aided in building Silurian and Devonian reefs and became responsible for bioherms of large size in the Mississippian, particularly in North America (Figure 2). Few reefs are known in the Pennsylvanian strata of North America, but algae are known to have been common, and reefs built by them are likely to be present. The Permian was a time of building of great reefs and reefs of great length and thickness are present in the rocks of this system in the Trans-Pecos Region of Texas and New Mexico and in Southeastern Russia.

Few reefs are known in Mesozoic formation of North America. This is probably because so much of the continent was land during the Triassic and Jurassic, and the Cretaceous waters of the interior and coastal areas do not seem to have been conducive to the growth of colonial organisms. The exposed Tertiary marine formations of the continent do not seem to contain many reefs, but it is not unlikely that some of the existing reefs of the present tropical waters are based on reefs of Tertiary age. Algal reefs that formed in continental waters are known in Texas, New Mexico, Kansas, and Colorado, and in the Green River shales of Wyoming, Colorado and Utah.

About the Author

W. H. TWENHOFEL, Orlando, Fla., formerly of the University of Wisconsin at Madison, is a recognized authority on reefs. He is active in the affairs and publications of the Society of Economic Paleontologists and Mineralogists and is one of about 15 honorary members of the American Association of Petroleum Geologists, election to honorary membership being an honor extended by the association to "persons who have contributed distinguished service to the cause of petroleum geology."

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Bore	7 1/16"		9"		11"		13 5/8"	
A—Height . . . inches	25	26 1/2	25 1/4	27 1/2	27 1/2	30 1/2	30	36 1/4
B—Width . . . . inches	28 5/8	31 1/2	31 5/8	35 1/4	34 1/4	37 5/8	40	40 1/2
C—Length . . . inches	70 3/4	70 3/4	71	72	79	81 1/4	88 1/2	88 1/2

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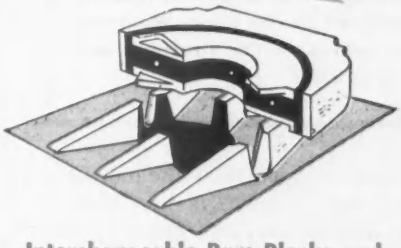

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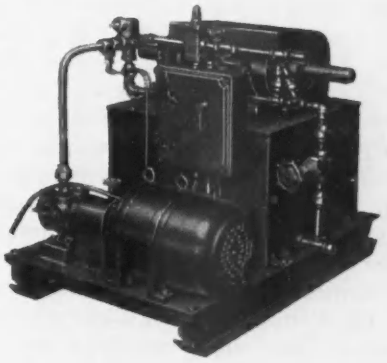
In addition Shaffer Hydraulic Gates can also be opened and closed mechanically, assuring full protection in case of power failures.



Centralized Control Panel

Complete control of the power closing unit, as well as of the opening and closing of the rams in both compartments of the Gate, is centralized in a compact unitized control panel that can be placed alongside of the driller or at any other convenient location.

Three manually-operated 4-way hydraulic valves are built into the panel—two of the hydraulic valves control the opening and closing of the rams—one for each compartment of the Double Gate—and the third valve can be used to control other hydraulic equipment or to operate another Gate.

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Rocky Mountain Type Structure

at Velma Pool, Stephens County, Oklahoma

By WILLIAM WYMAN MALLORY
Phillips Petroleum Company, Bartlesville, Okla.

IN 1941 the Velma pool of Stephens County in southern Oklahoma was considered a stripper area. Under the impetus of war, Oklahoma operators, notably Skelly Oil Company, reentered the area and undertook an extensive drilling campaign. New and deeper horizons were found and the pool attained rank as Oklahoma's biggest producer. During the course of this work, however, geologists and geophysicists unraveled one of the most complex geological patterns ever to have been laid down in the Mid-Continent area. It is almost axiomatic to say that every well drilled in Velma is a wildcat. Comprehension of this complex, mountain type structure undoubtedly will assist the industry in solving geological and geophysical problems encountered in the Rocky Mountain region where similar structures are known to exist.

VELMA pool is in E½-1S-5W Stephens County, Oklahoma, and extends into adjoining townships at the southeast corner. On the surface a prominent northwest-southeast anticlinal ridge is formed of the red sandstone series of the Permian Wichita-Clearfork formation. The Velma anticline is on the axis of a deep Pennsylvania depositional basin, trending northwest-southeast, the Anadarko-Ardmore geosyncline. The easternmost surface expression of this geosyncline is in Carter County and is represented by the complex Arbuckle anticline (western Arbuckle Mountains) together with the associated Ardmore basin, a highly compressed synclinorium. The geosyncline can be traced still farther east in wells beneath the Cretaceous overlap, and may continue indefinitely under the Ouachita overthrust sheets. Northwest of the Arbuckle anticline-Ardmore basin area the axis of the trough extends into northeast Stephens, northeast Comanche, southeast Grady, and Caddo counties, Oklahoma. In western Caddo County the axis bends, trending almost due west, and continues toward the Oklahoma-Texas Panhandle line. In Carter, Stephens, Garvin, Grady, and Caddo counties a series of buried mountain structures has caused the oil and gas accumulation in the Graham, Fox, Milroy, Velma, Cruce, Robberson, Knox, Chickasha, Cement, Apache, and other fields.

The Amarillo arch, Wichita Mountains, North Duncan, Empire, Comanche, Loco, Healdton, Hewitt, and Brock oil pool structures, together with the Criner Hills, comprise a complex anticlinal trend which forms the southern boundary of the geosyncline. Throughout its length the axis of the geosyncline is only 18-20 miles north of the Wichita-Criner Hills axis. Consequently, some Pennsylvanian formations thicken from absence to maxima in thousands of feet within this short distance. Except in the Arbuckle Mountains, the northern boundary, by contrast, is less sharply defined. Formations dip gently south, thin, and change facies gradually northward. Robert R. Wheeler's paper[1] is the classic reference for description and maps of the stratigraphy on the north flank of the Anadarko-Ardmore geosyncline. In the Arbuckle Mountains the northern limit of the geosyncline is formed by Wheeler's Elmore embayment and its eastern continuation, the Mill Creek syncline, which separate the Arbuckle anticline and the Hunton-Tishomingo uplift (eastern Arbuckle Mountains).

Stratigraphic and Structual History

The pre-Mississippian sediments of the Anadarko-Ardmore geosyncline are nearly 11,000 feet thick and consist principally of limestone. Cambro-Ordovician formations (the Arbuckle limestone, Simpson group, Viola limestone, and Sylvan shale) account for 9000 feet. The Siluro-Devonian Hunton limestones, and the early Mississippian Woodford chert and Sycamore limestone make up the remainder. The same formations are recognized in the northeastern half of Oklahoma where the total thickness is only 1000 to 1500 feet. The much greater thickness in the region of the geosyncline shows that this belt consistently sank more rapidly than the region on the north and east.

During Upper Mississippian and Pennsylvanian time conditions governing sedimentation differed radically from those operative in the early Paleozoic. Chesterian and Lower Morrowan deposits in the Anadarko-Ardmore geosyncline are variously termed Caney shale, Mississippian-Caney, Penn-Caney, Springer Caney and Springer because of difficulty in determining the systemic boundary, because of post-Springer truncation, and because of the need for standardization of terms. The 2500-3500 feet of "Springer-Caney" consists of a lower shale and an upper sand sequence which is limited to the Anadarko-Ardmore geosyncline. It is described by van der Gracht as an "orogenic deposit" and compared with the Stanley-Jackford sequence of the Ouachita region. Both the "Springer-Caney" and the Stanley-Jackford sequences are said to have been derived from a common source south of the present Ouachitas since no uplifts adjacent to the Anadarko-Ardmore geosyncline were yet in existence. The presence of an orogenic deposit limited to the geosyncline is the only effect in the Anadarko-Ardmore region of the early phase of the Wichita orogeny of late Mississippian time.

The late phase of the Wichita orogeny

at the end of the Morrow affected the entire Mid-Continent region. Many structures were created in Kansas and Oklahoma. Among these is the Nemaha-Oklahoma City anticline. In south-central Oklahoma the Hunton-Tishomingo uplift was formed. The Wichita-Criner Hills axis experienced its principal period of folding, the Anadarko-Ardmore geosyncline assumed its full proportions, and incipient structures within the geosyncline emerged and experienced local removal of the upper Springer (Springer sand) creating flank sand wedges which today yield oil prolifically. Flank Springer sands occur at Velma, Carter-Knox, Chitwood, Northeast Hobart, and Graham fields.

Upper Morrow, Lampasas, Des Moines, and Missouri sediments of the Anadarko-Ardmore geosyncline, the Dornick Hills, Deese, and Hoxbar formations are clastic deposits of mixed lithologic character with a total thickness of 15,000 feet near Ardmore. They have been described in the type area by Tomlinson and are recognized in the sub-surface part of the Anadarko-Ardmore geosyncline northwest of Ardmore, although separation of these formations in some parts of the sub-surface is controversial because of lithologic similarities and absense of adequate standards.

Dornick Hills Difficult

The Dornick Hills is especially difficult to identify. At Velma it consists of thin sandstones and limestones interbedded with dark gray, carbonaceous shales in the upper part which grade downward into flaky, papery, fissile shales similar to those of the Springer. The Deese formation is composed principally of shales varying in color from red to brown, gray, and green with some interbedded calcareous sands and arkosic lenses. The Deese formation rests with apparent local conformity on the Dornick Hills. Recent wells on the east flank, however, penetrate Dornick Hills beds younger than those higher on the structure. The Hoxbar formation consists of brown to green-gray shales at the top which grade downward into dark gray, micaceous shales interbedded with limestones and sandstones. The County Line limestone occurs near the top of the formation, and an oolitic sandy limestone occurs at the base. The Hoxbar may lie conformably on the Deese excepting at Velma, Tussy, Lone Grove, and possibly Cement and Chichasha oil fields. The oolitic sandy limestone forming the base of the Hoxbar in some places resembles the underlying Culberson zone at the top of the Deese. The formations of this group are orogenic deposits resulting from movements ascribed to the late phase of the Wichita orogeny.

During the Arbuckle orogeny of middle Cisco time the eastern part of the Wichita-Criner Hills system was thrust still farther north and the Anadarko-Ardmore geosyncline was destroyed as a marine sedimentary basin. Folding, overturning, and thrusting occurred in the geosyncline creating the Ardmore basin, the Arbuckle anticline and related subsurface structures at, for example, Eola, Robberson, Doyle, Cruce, and Velma.

The Virgil series of the Ardmore

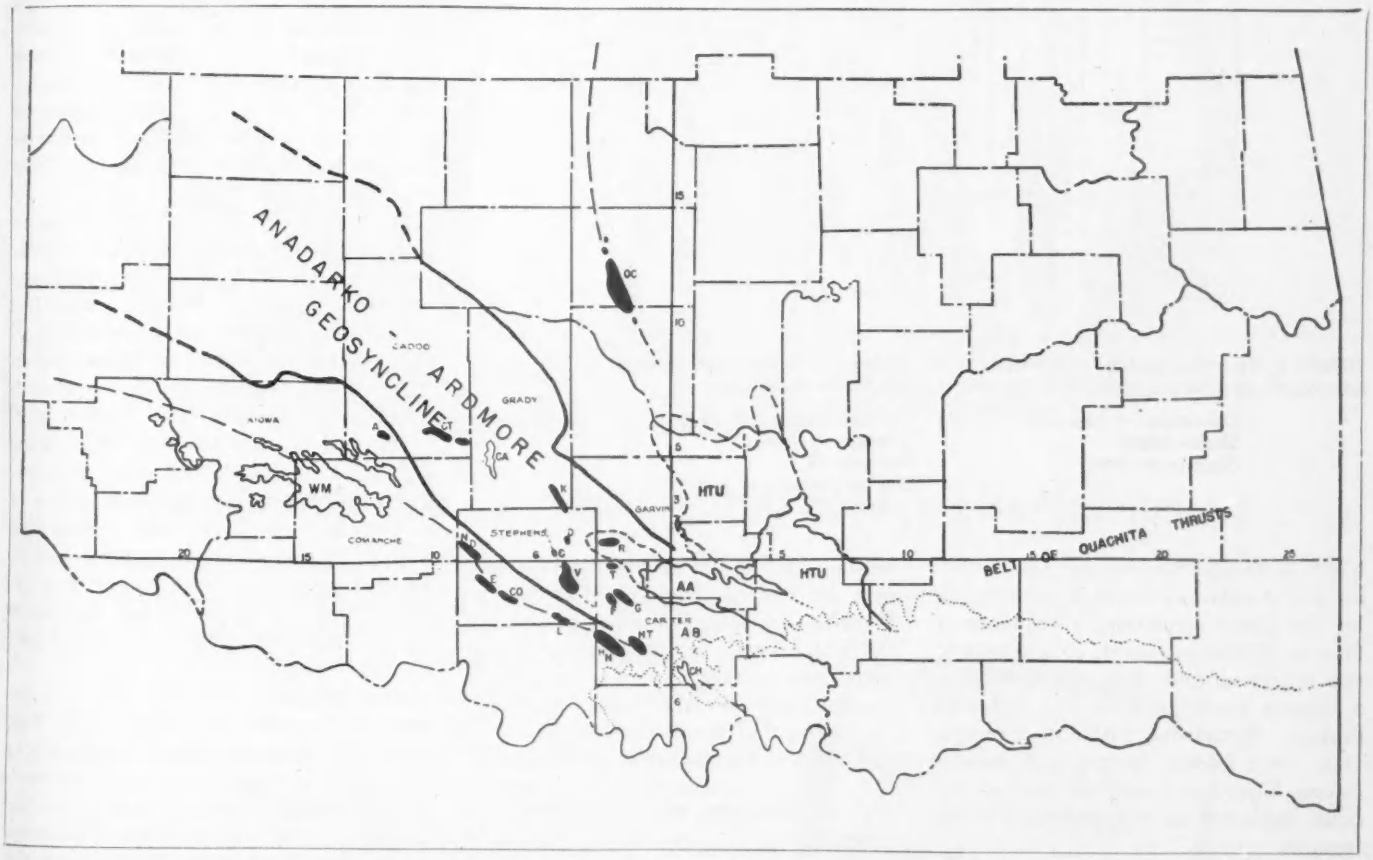

FIGURE 1. Regional index map of southern Oklahoma. County lines, Indian Meridian and Base Line with spaced townships and ranges are shown as control. Anadarko-Ardmore geosyncline is bounded by two semi-parallel, heavy northwest-southeast lines in west half of region. Solid irregular lines in south-central area indicate where early Paleozoic or pre-Cambrian rocks of Arbuckle and Wichita mountains are exposed; broken continuations indicate sub-surface extension of two major components of Arbuckle Mountains, Hunton-Tishomingo uplift, and Arbuckle anticline. Wichita-Criner Hills axis is indicated by dashed line connecting Wichita Mountains, North Duncan, Empire, Comanche, Loco, Healdton, and Hewitt oil fields and Criner Hills. Isolated broken line in north-central region indicates trend of Nemaha-Oklahoma City anticline. Dotted line shows north edge of Cretaceous overlap. Solid black areas represent oil pools. Specifically named areas identified by code letters.

AA Arbuckle anticline
AB Ardmore basin
HTU Hunton-Tishomingo uplift
CH Criner Hills
WM Wichita Mountains
A Apache oil pool
C Cruce oil pool
CO Comanche oil pool
CT Cement oil pool
D Doyle oil pool
E Empire oil pool
F Fox oil pool
G Graham oil pool
HN Healdton oil pool
HT Hewitt oil pool
K Carter-Knox oil pool
L Loco oil pool
ND North Duncan oil pool
OC Oklahoma City oil pool
R Robberson oil pool
T Tussy oil pool
V Velma oil pool
CA Chickasha gas pool

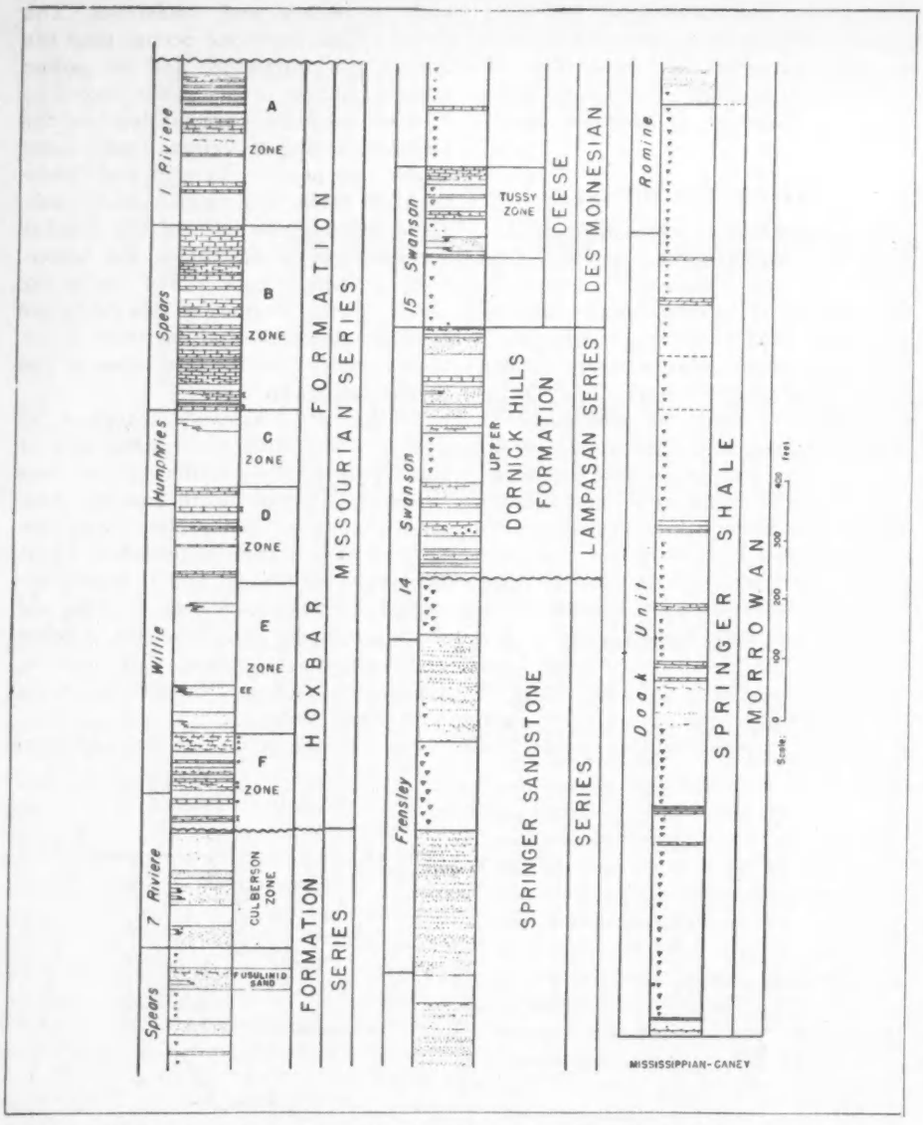

FIGURE 2. Reference section of Pennsylvanian rocks east of thrust fault, Velma pool. Names in left column refer to well from which segment is taken. Conventions used:

Limestone—bricks
Shale—blank
Sandstone—dots
Oolites—circles (beside log)
Siderite—triangles
Feldspar—X's
Chert—crosses

basin is represented in the sub-surface of the Anadarko-Ardmore geosyncline by the Cisco formation, a sequence of fine- to medium-grained, conglomeratic, red limestone and shale. It is, in turn, a deposit resulting from the Arbuckle orogeny. Structures within the geosyncline were folded, faulted, and beveled during Cisco time and the derived material deposited in surrounding synclinal troughs.

Pennsylvania sedimentation was closed by deposition of the early Permian Pontotoc redbed blanket which spread westward over the Anadarko-Ardmore geosyncline from the newly formed Arbuckle Mountains highlands. The late phase of the Arbuckle orogeny, dated as probably early Permain by van der Gracht, was expressed in the Ouachita Mountains by overthrusting. In the Anadarko-Ardmore geosyncline normal faulting and gentle arching at this time may be related. Faults which cut the Wichita-Clearfork formation of Leonard age occur north of the Wichita Mountains, and at the West Cement pool a normal fault displaces lower Pontotoc. At Velma the Permian cover (Pontotoc and Wichita-Clearfork) is gently arched.

Stratigraphy of Velma Pool

Stratigraphy in the Pennsylvanian of southern Oklahoma has provincial aspects. The widespread and almost continuous tectonic activity in the region during this period caused constantly changing environments. Hence, it is typical of these rocks that: (1) clastics predominate, (2) great thicknesses decrease to absence in short distances, and (3) facies changes are common.

All strata at Velma older than Virgil have been subjected to intense deformation and present a complex geologic pattern at the unconformity surface. An areal map of the rocks below the unconformity was constructed from well logs. Most of the deep wells are east of a major thrust. For this area, therefore, a composite reference section of the 4,350 feet of Hoxbar, Deese, Dornick Hills, and Springer formations was established (Figure 2). Many deep wells in 10-1S-5W penetrate a nearly complete section. Turner's Riviere 6, SE SW NE is probably the best single well in the pool to use as a standard although its apparent thicknesses are a little greater than average, the sands in the Dornick Hills are not typically developed and the larger part of the Springer sand section is lacking. The six distinctive lithologic zones recognizable in the Hoxbar permit detailed mapping of the unconformity (Figure 6).

CISCO FORMATION: Progressing downward from the surface at Velma the drill passes through the mildly arched Wichita-Clearfork formation at the surface and the underlying Pontotoc redbeds of Permian age. The next oldest rocks, the Cisco formation of Virgil age, occur as a wedge of red shales, minor sandstones, and numerous thin clastic limestones along the eastern margin of the pool. These beds are absent west of a line striking northwest and thicken eastward at a rate of about 700 feet in one-half mile.

HOXBAR FORMATION: Missouri beds of the Ardmore basin are wholly represented by the Hoxbar formation of mixed lithology which is 4000 feet thick south of Ardmore. At Velma pool the Hoxbar is 1100 feet thick and is divisible lithologically from top to bottom into six zones lettered from A to F.

DEESE FORMATION: The Deese formation is the Des Moines representative in the Ardmore basin where it is 8000 feet thick. At Velma pool it is about 725 feet thick. It consists largely of dark gray shale with traces of gray-green shale although three calcareous sandy zones make up a substantial part of the formation.

The Hoxbar formation lies disconformably on the Deese at Velma. Part or all of the upper 180 feet of the Deese formation is missing from well to well, a fact which has contributed to the controversy in determining the contact of the two formations. In all wells the F-zone of oolitic sandy limestones forming the base of the Hoxbar is present, but the erratic occurrence of the upper 180 feet of the Deese is evidence for a disconformity between the two formations and the placement of beds below the F-zone in the lower formation.

The Deese is not so readily divisible into units as the Hoxbar but has three recognizable zones at Velma sometimes

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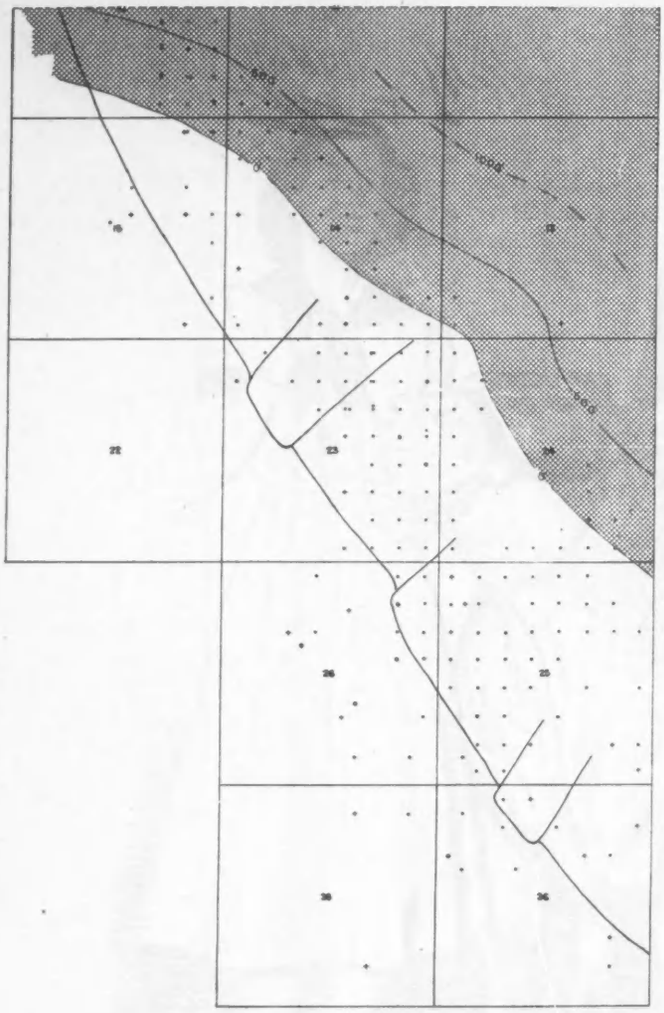

FIGURE 3. Distribution and thickness of Cisco formation. Isopach interval, 500 feet.

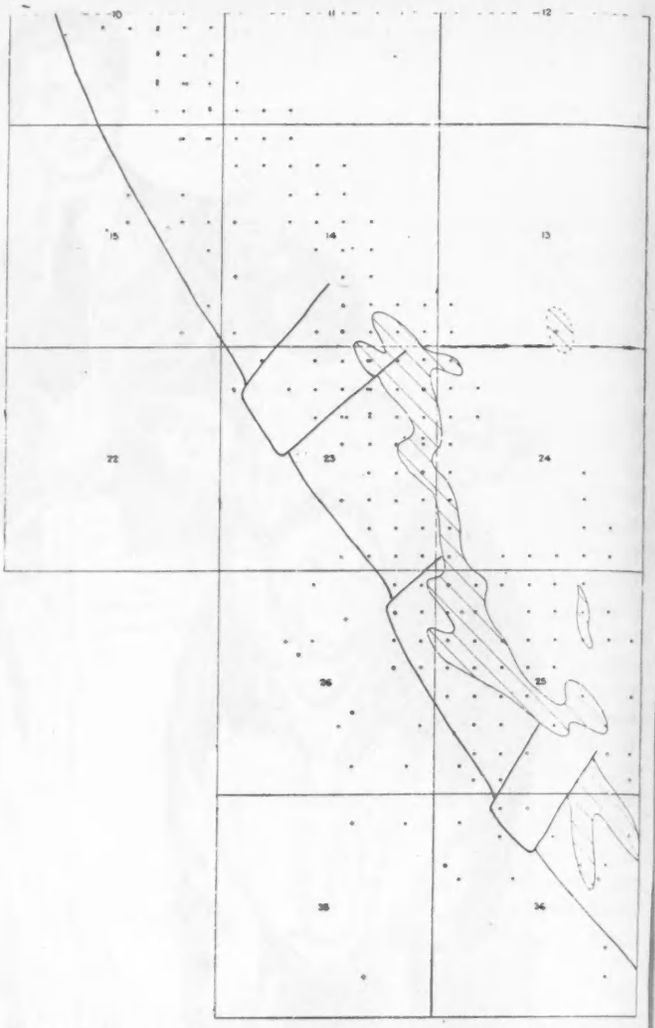

FIGURE 4. Map of Velma pool showing areas (lined) where Culberson zone is absent because of pre-Hoxbar removal.

referred to as the Culberson zone, the Fusulinid sand, and the Tussy zone.

DORNICK HILLS FORMATION: The Dornick Hills formation of the Ardmore basin, 2800 feet thick, is upper Morrow (Johns Valley) and Lampasas (Atoka) in age. At the Velma pool it has a true thickness of about 365 feet. The Dornick Hills formation of the a sequence of buff, chalky to clastic limestones, and brown very fine-grained, shaly sandstones, commonly cherty and arkosic. These are interbedded with gray, fine-textured shales similar to those of the Springer formation. No division into regularly recognizable zones is possible. The small thickness of this formation and the presence of an unconformity at its base imply that it is Upper Dornick Hills only (Lampasas) and that the lower Dornick Hills (Morrow) of the Ardmore basin is absent at Velma.

SPRINGER FORMATION: The Springer formation in the Ardmore basin is lower Morrow (Stanley-Jackfork) in age. It consists of about 3000 feet of dark, gray, bituminous shales containing four conspicuous sandstone members. At Velma the Springer formation is 2150 feet thick and consists of an upper sandy sequence and a lower shale section. Determination of the top of the Springer formation in the substance is a controversial subject. A problem exists because (1) the lithologic characteristics of the gray, flaky, papery shales of the lower Dornick Hills and upper Springer formations are similar, (2) the unconformity separating these formations creates confusion, and (3) different geologists find different criteria convenient for separating one from the other.

The Springer sandstone consists of a sequence of numerous thin to medium thick (2-30 feet) brown, fine-grained, somewhat cross-laminated sandstones closely interbedded with gray, flaky, papery, sideritic shale. Little to no limestone is present. The Springer shale is gray, flaky, sideritic, and in places slightly sandy shale with some thin (2-10 feet) sandy limestones. In the approximate lower half some gray-green shale is present and thin limestones and dolomites are more numerous. The Springer shale or Penn-Caney lies with apparent conformity on the Mississippian-Caney shale.

The Springer formation of that area at Velma east of the major fault has undergone removal of the upper sandstone section from a structurally high belt. The Springer sandstone is therefore found as a northwest-southeast striking wedge thickening downdip, eastward, at about 500 feet in quarter-mile (Figures 5 and 7). In other words, this zone was so sharply beveled in post-Springer time (late Wichita orogeny) that it thins from maximum thickness to absence in less than one-half mile.

Structure of Velma Pool

The main structural feature causing accumulation of oil in the Velma pool is a complex anticline trending northwest-southeast which occupies nearly all of 1S-5W (Figure 9). The highest part of the structure occurs in Sects. 22, 26, 27, and 35. It is here that oil was produced, in the early development of the pool, from shallow Permian sands. Deeper drilling on the east side of the surface high revealed accumulation in disturbed Pennsylvanian and older rocks which occur as a band extending south-

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probe with compressed air, time otherwise requ
the tube is reduced. Figure 2 illustrates the use of the air gun.
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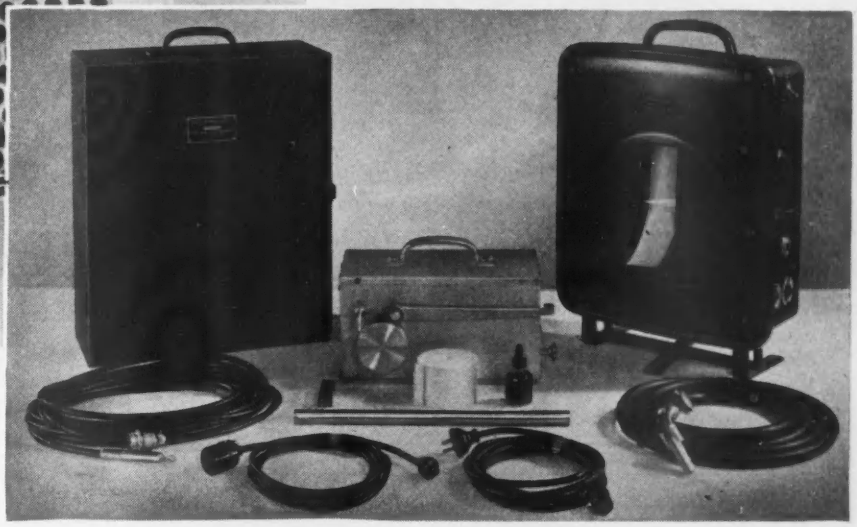

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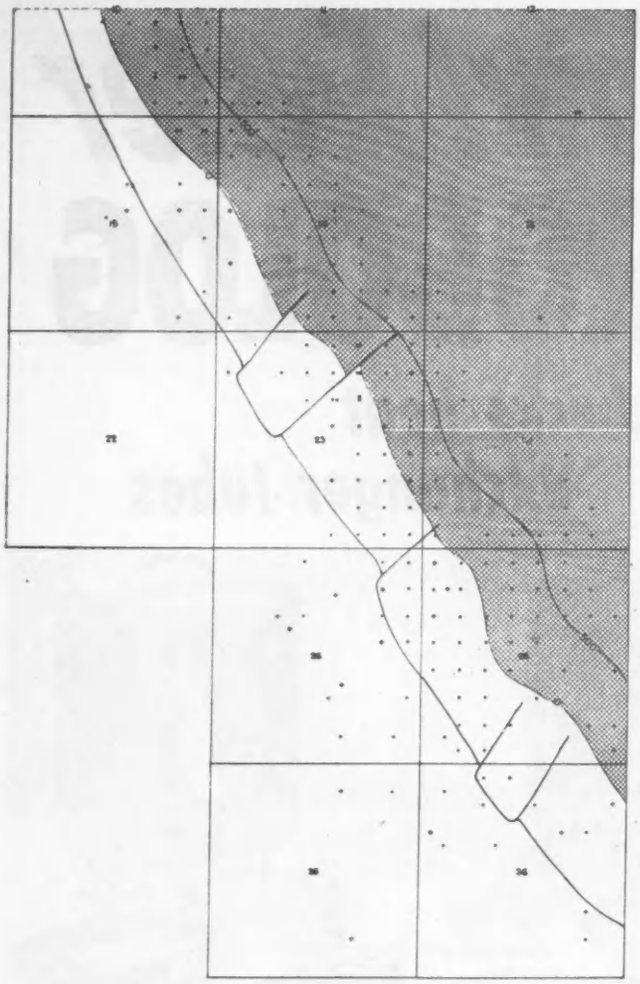

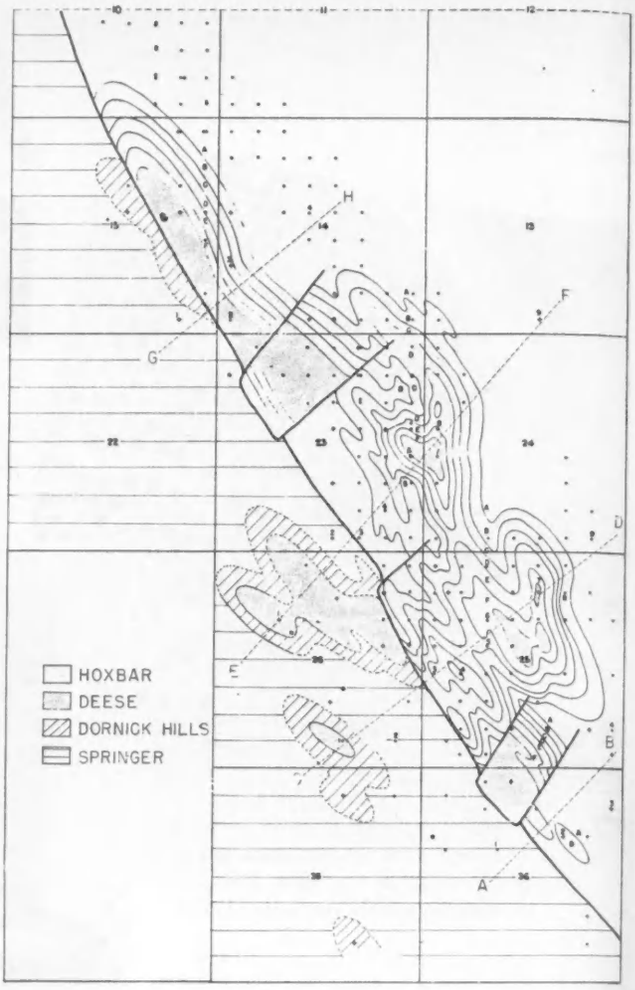

FIGURE 5 (Above left). Thickness and distribution of Springer sandstone.

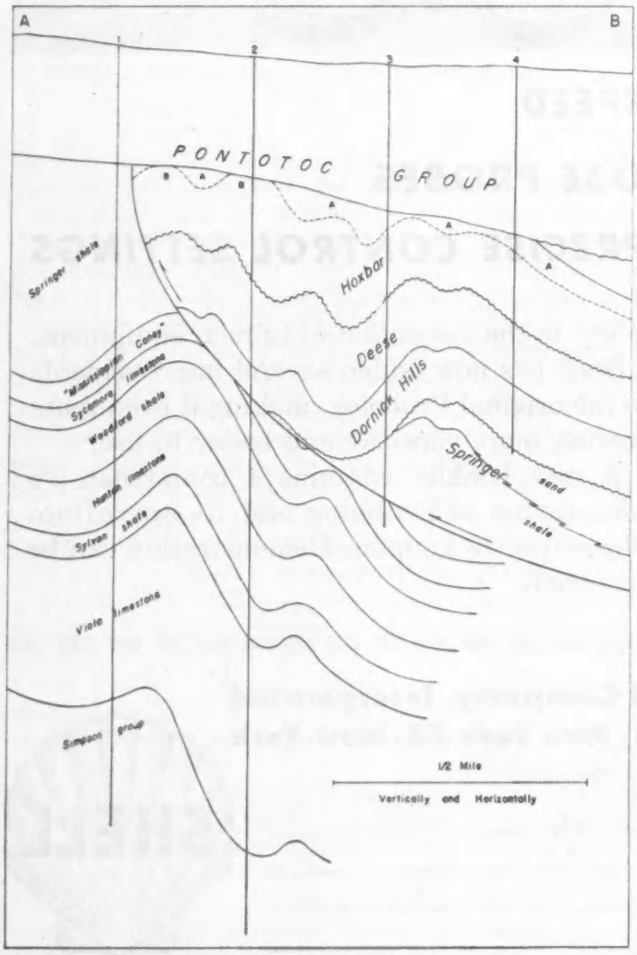

FIGURE 6 (Above right). Pre-Cisco areal geologic map of Velma pool. Permian and Cisco redbeds unconformably overlie mapped formations. Hoxbar zones designated by letter.

FIGURE 7 (Left). Northeast-southwest cross section AB (see Figure 6). 1. Skelly's Martin 1-D, C SE NW 36-1s-5w. 2. Skelly's Kuekel 1, NE SW NE 36-1s-5w. 3. Skelly's Kuekel 2, SE NE NE 36-1s-5w. 4. Champlin's Pearson 1, NE SE SE 25-1s-5w.

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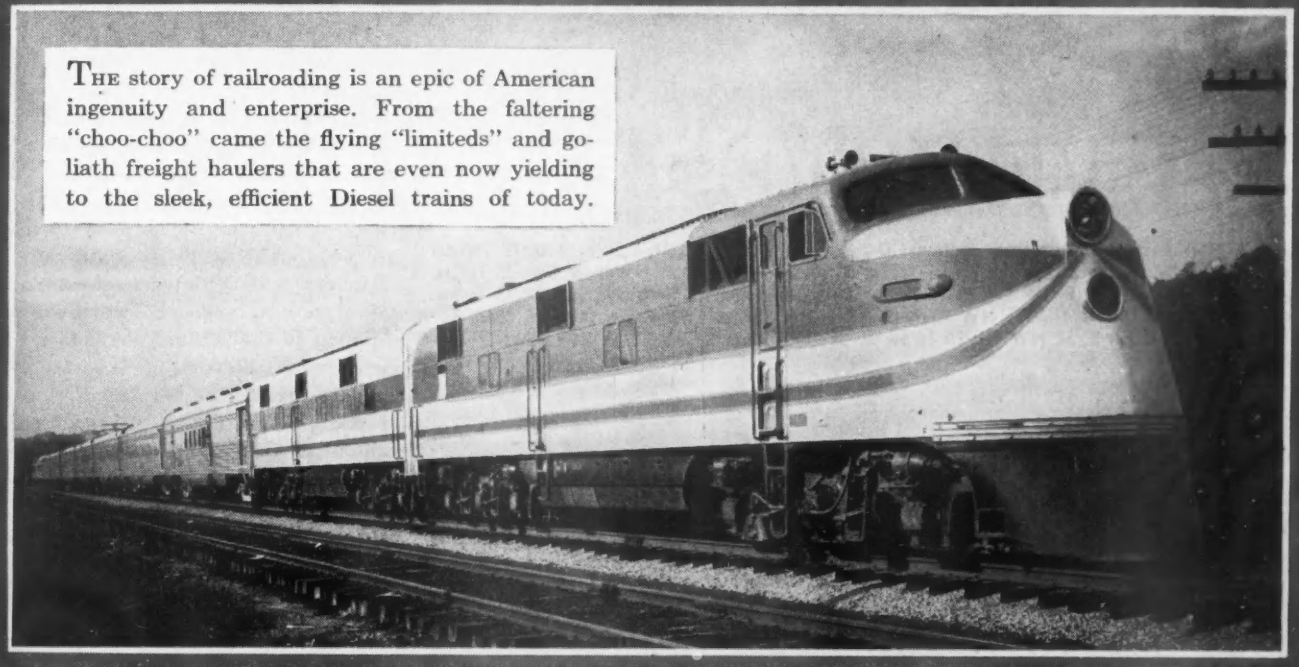

THE story of railroading is an epic of American ingenuity and enterprise. From the faltering "choo-choo" came the flying "limiteds" and goliath freight haulers that are even now yielding to the sleek, efficient Diesel trains of today.

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southeast from Sect. 10 to Sect. 36. It is principally these flank wells, producing from Pennsylvanian and older rocks, that provide information about sub-unconformity structure. Recent studies of West Velma pool in the west part of 1S-5W, suggest that the main Velma-West Velma anticline possesses a general symmetry in which the west flank (West Velma) roughly mirrors the structure of the east flank (Velma).

The pre-Permian rocks in the central part of the main Velma-West Velma anticline are known from only a few deep holes. They consist principally of closely folded Springer and Dornick Hills at the unconformity. Infolded remnants of Deese are preserved along synclinal axes in Sect. 26.

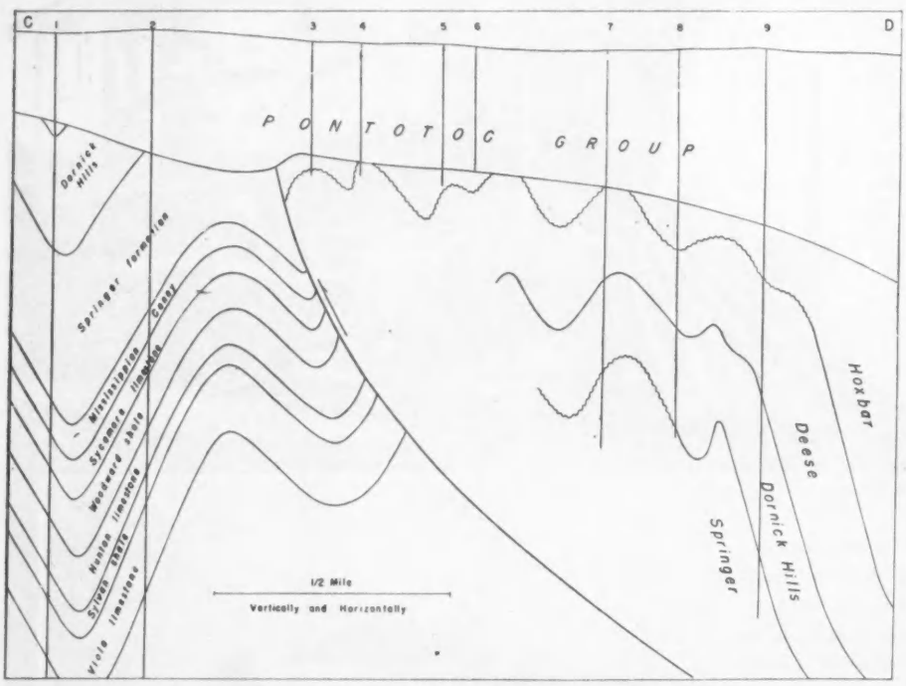

FIGURE 8. Northeast-southwest cross section CD (see Figure 6). 1. Skelly's Selby 1-D, C SW SE 26-1s-5w. 2. Skelly's Selby 2-D, C SE SE 26-1s-5w. 3. Skelly's Winans 4, NW NW SW 25-1s-5w. 4. Skelly's Winans Unit 1, NE NW SW 25-1s-5w. 5. Skelly's Dickerson Unit 1, SW SE NW 25-1s-5w. 6. Skelly's Dickerson Unit 2, NW SE NW 25-1s-5w. 7. Skelly's Frensley 2, C SW NW NE 25-1s-5w. 8. Skelly's Baker 1, SE NW NE 25-1s-5w. 9. Skelly's Baker 2, SW SE SE 24-1s-5w.

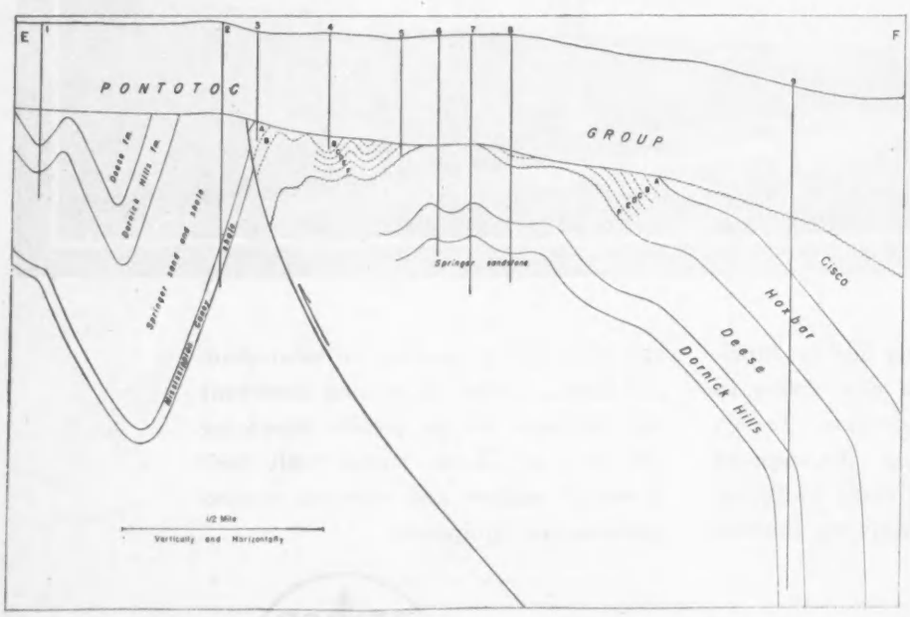

FIGURE 9. Northeast-southwest cross section EF (see Figure 6). 1. Mudge's Woods 49, NW SE NW 26-1s-5w. 2. Phillips' Quinn 14, SW SW SE 23-1s-5w. 3. Phillips' Quinn 2, SE SW SE 23-1s-5w. 4. Phillips' Quinn 6, NW SE SE 23-1s-5w. 5. Phillips' Quinn 9, SE NE SE 23-1s-5w. 6. Phillips' Quinn 10, NE NE SE 23-1s-5w. 7. Skelly's Frensley "E" 4, NW NW SW 24-1s-5w. 8. Skelly's Frensley "J" 1, SW SW NW 24-1s-5w. 9. Carl Carter's Jones 1, SW SW SE 13-1s-5w.

A northwest-southeast-trending thrust sharply divides the central part from the east flank, or east block. The inclination of the fault is steep at the unconformity but decreases with depth, especially at the south end. The east block consists of an overturned complex anticline compressed into many small folds shown in plan on the geologic map of the unconformity (Figure 6) and in cross sections.

Five mappable tear faults, transverse to the thrust fault, divide the eastern block into segments. Maximum displacement along these tears have been relatively small, probably a few hundred feet. Dips in the eastern block range from 20 to 45 degrees on the crest of the anticline but steepen abruptly near the east margin of the pool.

Structural History of Velma Pool

The thinning and disappearance of the Springer sandstone and the spotty absence of the upper Deese formation show actual emergence and erosion immediately following the deposition of these formations.

The thickness of the pre-Virgil Pennsylvanian in the Ardmore basin, 35 miles southeast of Velma, totals about 17,800 feet. The Gulf et al. Qualls 1, SW NE 23-1N-7W, a dry hole 12 miles northwest of Velma, is in the Deese formation at the total depth of 10,157 feet. If the 2400 feet of Hoxbar formation in the Qualls well is compared with 4000 feet near Ardmore, an estimate of the rate of regional northwestward thinning in the Ardmore-Anadarko geosyncline may be computed. Interpolating proportionally, the expected thickness of the pre-Virgil (pre-Cisco) Pennsylvanian at Velma would be three times the actual thickness. Instead of thickening by steady accretion of sediment as at normal depths, the Velma section was often in a state of delicate balance between diastem and deposition. Constant subjection to the vagaries of surface currents can account for erratic behavior of individual beds associated with maintenance of identity of larger zones.

Hence, three lines of evidence, (1) interformational unconformities, (2) abbreviated thickness, and (3) nature of sedimentation, indicate that the site of Velma pool persistently sank less than surrounding areas during Pennsylvanian time. A persistently less negative and recurrently positive tendency throughout the Pennsylvanian was climaxed in post-Hoxbar time by orogenic deformation. Contrary to the ordinary conditions younger rocks are thrust upon older at Velma. This contingency eliminates the possibility that the Velma thrust occurred as simple shortening of an es-

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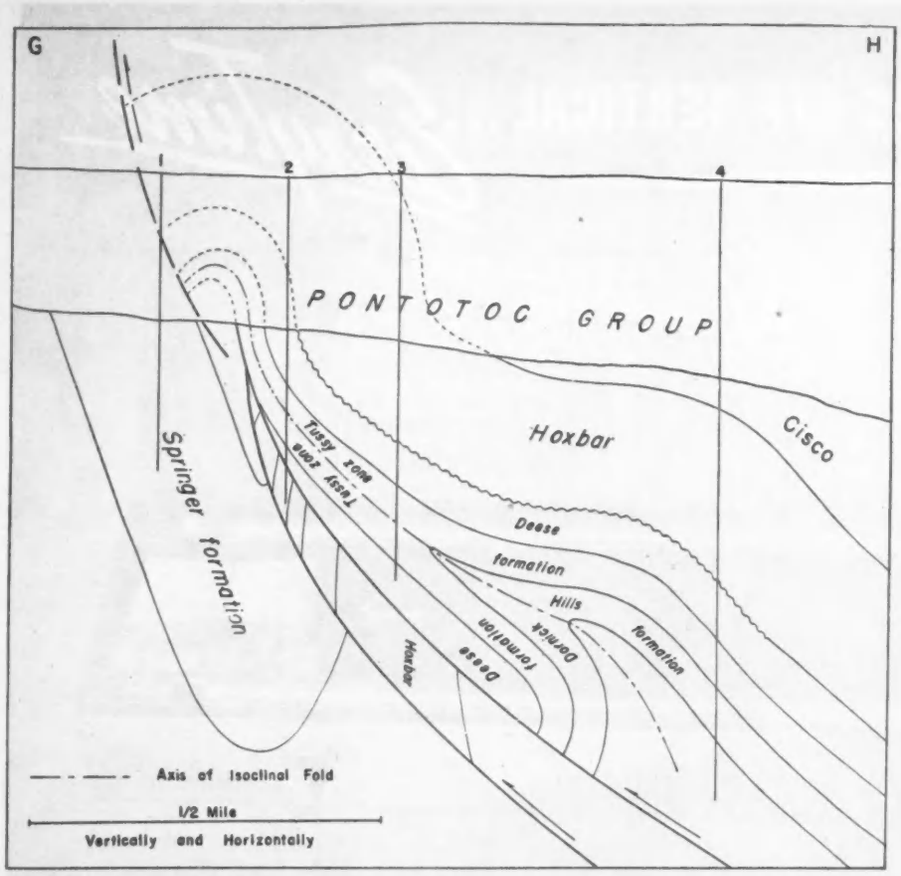

FIGURE 10. Northeast-southwest cross section GH (see Figure 6). 1. Turner's Spears 1, SW SE SE 15-1s-5w. 2. Gulf's Spears 1, SW SW SW 14-1s-5w. 3. Gulf's Spears 2, SW NW SW 14-1s-5w. 4. Sinclair-Prairie's Spears 3, SE SE NW 14-1s-5w.

sentially horizontal section along a low-angle interface. The condition is typical of normal faulting and eliminates the possibility of proving the fault a thrust by demonstrating that a block of older beds lies on younger beds in normal succession. Nevertheless, the weight of evidence favors calling the fault a thrust.

To show how younger beds may lie in thrust contact on older, the following concept of the mechanics of faulting at Velma is presented. The center of the main Velma structure, possessing tendencies to rise throughout the Pennsylvanian, was compressed into tight overturned folds subjected to overthrusting, and bowed upward into a complex arch. Continued compression and arching of the central mass produced a subsidiary arch on its east flank, which in turn was folded, and later overturned toward the axis of the main arch. Excessive slippage along planes in the shaly Deese zone permitted the formation of a recumbent fold at the north and south ends of the pool (Figure 10, cross section GH). Progressive compression (1) attentuated and sheared the overturned limb of the subsidiary, flank anticline, (2) sheared the east side of the main arch, and (3) slowly thrust the eastern, subsidiary, folded block upward to its present position nearer, but still well below, the structural elevation of the main arch. Further compression squeezed the central part of the major uplift higher so rapidly that additional thrust movement along the oblique fracture did not materialize; instead, the upward movement of the central axis caused the hanging wall to lag behind and to assume the appearance of a normal fault. That the major compression affected the deep rocks of the main axis is also shown by the greater amplitude of the folds within it (southwest of the fault) in comparison with the much shallower folds in high beds (northeast of the fault). From the foregoing description of structural movements along the major fault at Velma it can be seen that no accepted fault terminology is completely correct. Faults are described as normal, reverse, or thrust. It is difficult to assign a type name to a fault (1) which is not normal, (2) along which crustal shortening took place and yet (3) on which, with regard to the allochthonous block, the autochthonous mass achieved higher structural elevation. "Thrust" is the most nearly adequate term.

Beveling accompanying deformation reduced the topographic elevation of both arches and contributed to deposition of the Cisco formation in the residual basin east of the complex Velma anticline. Pontotoc and younger Permian sediments then buried the entire structure.

Because of the inclination of the thrust plane and the large vertical component in the movement of the overthrust block, total horizontal displacement is estimated at a mile or two. Similar thickness and reasonably similar lithologic character of the Hoxbar formation of West Velma to that of Velma pool (Sect. 19 vs. Sect. 25) support the assumption of moderate original (prediastrophic) horizontal separation of the two areas. Late phase diastrophism (see section on regional structural history) was expressed as arching of the Permian cover to form the present surface structure which led to discovery of the pool.

ACKNOWLEDGMENT

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REFERENCE

[a]Anadarko Basin Geology and Oil Possibilities, World Oil, Vol. 127, Nos. 4, 5, 7 and 8.

About the Author

WILLIAM W. MALLORY is qualified to write about the Velma pool of Stephens County by a scholastic career distinguished by exceptionally fine work in geology. Born in New Rochelle, N. Y., he graduated from Columbia University in 1939 with an A.B. with honors in geology. He has won two scholarships, the Henry Evans Traveling Fellowship and the Carlton Dows Cooksey, Jr., Memorial Scholarship. They have permitted him to undertake post-graduate studies at Columbia, Wyoming and Yale universities. He was a Trustee Appointee in Geology at Columbia in 1940-41; studied under Faculty of Pure Science at Columbia during the same period, and was readmitted under Faculty of Pure Science at Columbia in 1945-46, receiving an M.A. degree in 1946 and becoming a senior candidate for a Ph.D. degree in the same year. He served in the U. S. Naval Reserve, 1941-43, and is now with Phillips Petroleum Company, Stratigraphic Exploration department, Mid-Continent area.

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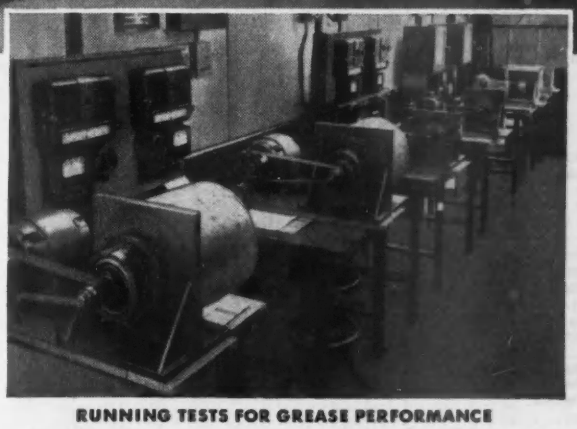

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Superior Well Passes Long-Time Goal of 20,000 Feet

By CECIL SMITH, Staff Writer

SINCE the first 10,000-foot well was drilled almost 20 years ago, men in the industry have dreamed of drilling to the seemingly impossible depth of 20,000 feet. It was natural for that to be the next goal for the progressive oil industry has never been quite satisfied that it had reached its maximum in any phase of activity.

However, it took The Superior Oil Company, the latest in deep drilling rigs, and 18 years more of drilling experience before a well had been drilled to 20,000 feet. This was accomplished in Superior's Pacific Creek Unit 1, a wildcat in Sublette County, Wyoming. Late in June this well had been taken to 20,521 feet and to that point drilling had proceeded remarkably well with little trouble reported. However, for several days reports from the well indicated that no further progress had been made, at least from a depth standpoint. This operation has been closely guarded and official information has been restricted to total depths almost exclusively.

Whether Superior decided to discontinue drilling or whether it had trouble in the hole was not known. The company had not made a statement as to why the operation stopped at that point.

Rumors have attended this well since

Summary of Results of Exploratory Drilling

ITEM	May, 1949	April, 1949	FIVE MONTHS: JANUARY-MAY 1949	1948	Percent Diff.
Oil Discoveries	77	93	386	325	+ 18.8
New Fields	50	58	263	194	+ 35.6
New Pays	27	35	123	131	— 6.1
Distillate Discoveries	16	15	64	38	+ 68.4
New Fields	10	8	35	18	+ 94.4
New Pays	6	7	29	20	+ 45.0
Gas Discoveries	7	15	53	52	+ 1.9
New Fields	5	11	42	36	+ 16.7
New Pays	2	4	11	16	— 31.3
Total Discoveries	100	123	503	415	+ 21.2
Extensions to Fields	20	27	107	80	+ 33.8
Oil Fields	18	22	96	63	+ 52.4
Distillate Fields	2	2	7	6	+ 16.7
Gas Fields	.....	3	4	11	— 63.6
Total Prod. Tests	120	150	610	495	+ 23.2
Dry Holes	534	500	2286	1946	+ 17.5
Wildcats	527	500	2261	1911	+ 18.3
New Pays	.....	.....	2	6	— 66.7
Outposts	7	.....	23	29	— 20.7
Total Expl'tory Tests	654	650	2896	2441	+ 18.6
Percent Productive	18.3	23.1	21.1	20.3	.....
Percent Dry	81.7	76.9	78.9	79.7	.....

Results of Exploratory Drilling in May and First 5 Months, 1949-1948, by Districts

State or District	MONTH OF MAY, 1949													FIRST FIVE MONTHS, 1949																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests									Total Productive	Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions										
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	5 Mo. 1949	5 Mo. 1948	Wildcats	New Pays	Outposts	5 Mo. 1949	5 Mo. 1948	5 Mo. 1949	5 Mo. 1948
Alabama																										6			6	6	6	6
Arizona																										3			3		3	
Arkansas											4			4	2			2						4	2	18			18	32	22	34
California	2			2						4	33			37	6		1	5			8		1	21	22	112		1	113	85	134	107
Colorado											9		1	10												17		1	18	18	18	18
Florida																										7			7	7	7	7
Georgia																										3			3	2	3	2
Illinois	2			2			5			9	39			48	4			9			21			34	33	172			172	163	206	196
Indiana	7			1			3			11	21			32	18			3			4			25	10	151			151	83	176	93
Kansas	5									5	39			44	25		2	1			3			31	31	151			151	169	182	200
Kentucky	1									1	4			5	3									3	4	14			14	17	17	21
Louisiana	2	3		3	1	1		1		11	28			39	14	5	3	11	12	1	4	1		51	42	91			91	86	142	128
North Louisiana		1			1					2	13			15	3	2	1		7					13	7	44			44	41	57	48
South Louisiana	2	2		3		1		1		9	15			24	11	3	2	11	5	1	4	1		38	35	47			47	45	85	80
Maryland																														1		1
Michigan	2						1			3	23			26	8		1				5			14	8	136		1	137	92	151	100
Mississippi	1									1	13			14	3			1						4	2	47			47	36	51	38
Missouri																										1			1	3	1	3
Montana											2		1	3	1									1	2	9		1	10	13	11	15
New Mexico	2			1						3	10			13	5			3						8	11	24			24	26	32	37
Ohio											4			4							2		1	3	9	18			18	15	21	24
Oklahoma	5		1			1				7	43			50	19	2	2	7	1	2	9			42	45	187			187	182	229	227
Pennsylvania																	1							1		1			1	2	2	2
South Dakota																																1
Tennessee											3			3	1									1	1	10			10	13	11	14
Texas	20	7	4	18	5		8	1		63	241		5	309	149	28	28	76	16	8	35	6	2	348	253	1,030	2	16	1048	865	1396	1118
Dist 1 S. Central											19			19	7						1			8	3	105			105	75	113	78
Dist. 2 Middle Gulf		3	1	1				1		6	11			17	3	11	6	5	1	2	1	2		31	33	64		3	67	86	98	119
Dist. 3 Upper Gulf	1	4		4	4					13	21			34	8	10	1	21	8	2	3	2		55	40	109			109	106	164	146
Dist. 4 L. Gulf-SW	2			5	1					8	33		1	42	6	5	6	23	5	4		1		50	40	161	1	5	167	144	217	184
Dist. 5 E. Central											6			6		1						1		2	5	34			34	29	36	34
Dist. 6 Northeast				1						1	10			11	3	1	2	1	2				1	10	11	27			27	31	37	42
Dist. 7-B N. Central	9			2			1			12	57			69	56		9	10			2			77	49	230	1		231	144	308	193
Dist. 7-C W Central			2	1			2			5	23		1	29	7		2	2			3			44	8	41		1	42	32	56	40
Dist. 8 West	2			1			3			6	22		1	29	18			4			17		1	40	31	76		3	79	69	119	100
Dist. 9 North	6		1	3			2			12	38		2	52	40		2	10			8			60	33	181		4	185	147	245	180
Dist. 10 Panhandle											1			1	1									1		2			2	2	3	2
Utah																					1			1	1	5			5	8	6	9
Virginia																									1							1
Washington																													1		1	1
West Virginia																	4							4	2	1			1		5	2
Wyoming	1						1			2	11			13	5			5			4			14	16	47		3	50	20	64	36
Total U.S.	50	10	5	27	6	2	18	2		120	527		7	654	263	35	42	123	29	11	96	7	4	610	495	2261	2	23	2286	1946	2896	2441

it came within striking distance of the world's depth record several months ago, as could be expected from a "tight" well in the limelight. Unconfirmed reports have placed oil shows as deep as 19,000 feet, and it has been reliably reported that the world's longest string of seven-inch casing has been cemented at approximately 19,735 feet.

May Reach 21,500

Shortly before the present depth was reached it was learned from a usually reliable source that Superior was headed for around 21,500 feet to have a look at a certain geological formation which was not named. Another report said the Dakota sandstone of the Cretaceous had not yet been reached. Of course, these reports remained unconfirmed.

The drilling of record-depth wells is not new to Superior, which has drilled the three deepest in the world. Its first record-breaker was completed in Oklahoma during 1947. This test held the record until the same firm bettered the mark in California earlier this year. At the time the California deep test was abandoned the Pacific Creek Unit 1 was close on its heels and there was little doubt that a new record would be made.

Equipped with the world's largest power rig the present test was marked from the outset as the one that would most likely be the first to reach the charmed 20,000-foot level. The combination of deep-drilling Superior and the large rig pointed to a testing of machinery and technique.

While this wildcat is breaking all depth records, the industry as a whole is well on its way toward setting a new all-time high in the number of exploratory wells drilled. At the end of five months these wells totaled 2896 for an increase of more than 18 percent over the 2441 exploratory completions made in the same period of 1948, which was the most active wildcatting year in history.

610 Successes

Not only has this type of well been more numerous, but the results have been slightly better from a mathematical viewpoint. For the first five months of this year 610 exploratory tests have been successful in proving production for a score of 21.1 percent of the total, while a year ago successes numbered 495 or 20.3 percent. New oil fields totaled 263 this year against 194 in five months of 1948. A slight decline in the number of new oil pays in old fields occurred, but the total new sources of oil amounting to 386 still top the 325 of a year ago by almost 19 percent.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in May, 1949
Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		CALIFORNIA—New Oil Fields						
Kern	Calder	General Petroleum Corp's KCL-Calder 38-23, 330 n 1650 e fr swc of 23-29s-25e, 2 mi w Greely fld.	5- 4-49	12733	8808- 8834	Stevens sd; Mio	F 180; 7 wtr; 17/64"	34.8
Santa Barbara	Cuyama, S.	Richfield Oil Corp's Homan A-81-35, 330 s&w fr nec of 35-10n-27w, 5½ mi se Russell Ranch fld.	5- 4-49	4392	4051- 4390	Dibblee sd; Mio	F 544; 35 wtr; 4/64"	34.2
		CALIFORNIA—New Oil Pays						
Fresno	Guijarral Hills	Barnsdall Oil Co's Allison 73-34, 993 n 990 w fr e¼ cor 34-20s-16e	4-28-49	8671	8168- 8243	Allison sd; Mio	F 423; ¼"	38
Kern	Devils Den	Honolulu Oil Corp's Alferitz 67, 990 n&e fr s¼ cor 14-25s-18e	5-22-49	2505	1545- 2505	Wagonwheel sh; Olig	P 183	18.1
		ILLINOIS—New Oil Fields						
Clinton	Keyesport	E. J. Goldschmidt's Goldschmidt 1, se nw ne 17-3n-2w, 1½ mi se Beaver Creek, S fld.	5-10-49	1185	1175- 1185	Bethel sd; Miss	P 17	....
Jasper	Bogota, N.	W. D. Schweitert's B. Freeman 1, (OWWO), e nw sw 15-6n-9e, 1½ mi s Newton, W. pl.	5-24-49	3130	.....	McClosky li; Miss	P 15; 35 wtr	....
		ILLINOIS—New Oil Pays						
Gallatin	Inman	C. E. Skile & Aurora Gasoline Co's Lawlor 2, sw sw se 13-8s-9e, 1 mi nw of prod.	5-31-49	2135	2123- 2128	Tar Springs sd; Miss	P 190; 19 wtr	....
White	New Haven, N.	George & Wrather & Duncan's H. Garrison 1, ne nw ne 3-7s-10e, ½ mi n of prod.	5-31-49	2160	2154- 2160	Waltersburg sd; Miss	P 367	....
		ILLINOIS—Oil Field Extensions						
Hamilton	Bungay Consol.	Ill.-Mid Continent Oil Co. & Aurora Gasoline Co's A. M. Thomas 1, sw se sw 12-4s-7e, ¾ mi e extension.	5-31-49	3345	3336- 3344	Aux Vases sd; Miss	P 170	....
Marion	Iuka	Winn & Beck's Cheeley 1 (OWWO), ne ne sw 3-2n-4e, 2 mi nw extension.	5-17-49	2807	2734- 2738	McClosky li; Miss	P 25	....
Richland	Olney, S.	Sun Drilling Co's Kaltrider 1, nw sw se 9-3n-10e, ½ mi n extension	5-10-49	3099	3094- 3097	Rosiclare li; Miss	P 25	....
Wabash	Allendale	Brehm's Dunkel 1, ne se ne 31-1n-12w, ½ mi extension	5-24-49	2385	2250- 2357	Rosiclare li; Miss	F 200	....
Wayne	Fairfield	Robinson & Puckett's Johnson 1, ne ne sw 9-2s-8e, ½ mi n extension	5-17-49	3161	3143- 3160	Aux Vases sd; Miss	P 40	....
		INDIANA—New Oil Fields						
Gibson	.....	Ryan & Sharp's Elsie Lewis et al 1, se se ne 35-2s-12w, 1 mi s Owensville N pl.	5-24-49	2567	2480- 2488	O'Hara li; Miss	P 30; 100 wtr	....
Jay	.....	Hoover & Walker's Herschel Loy 1, nw se se 15-23n-15e, Noble Twp.	4-12-49	1129	1102- 1129	Trenton sd; Ord	P 10	....
Knox	.....	John M. Zanetis' Ottis & Anna Gilliatt 1, 260 fr sl 300 fr wl sw 20-3n-10w, Vicennes Twp.	4-14-49	1915	1865- 1892	O'Hara-Rosiclare sd; Miss	P 20	....
Pike	.....	W. R. White et al's F. M. Neal 1, ne nw nw 13-1n-8w, 2 mi n Petersburg pl.	5-26-49	1302	1297- 1302	Rosiclare li; Miss	P 85	....
Posey	.....	B. M. Heath's S. L. Highman 1, se se sw 18-8s-13w, 1¾ mi se Spencer pl.	5-24-49	2751	2630- 2716	McClosky li; Miss	P 165	....
Posey	.....	A. J. Slagter Jr's Elizabeth Utley et al 1, nw sw ne 26-6s-13w, w of Bufkin pl.	5-24-49	2433	2429- 2433	Cypress sd; Miss	P 22	....
Vigo	.....	G. H. Froderman's J T & J S Royse 1, nw ne se 9-11n-9w, 2 mi nw Spring Hill pl.	5-17-49	1752	1680- 1710	Devonian sd; Devo	P 60	....
		INDIANA—New Oil Pay						
Sullivan	Oaktown	Ill.-Mid Continent Oil Co et al's Nellie Walden 1, nw sw se 3-5n-10w	5-19-49	2910	1858- 1874	Salem li; L Miss	P 35	....
		INDIANA—Oil Field Extensions						
Gibson	Owensville, N	G. W. Evans' Nancy E. Marvel 1, ne nw nw 31-3s-11w, ½ mi s extension	4- 6-49	2041	1996- 2027	Cypress sd; Miss	P 125	....
Gibson	Owensville, N	Wm A. Schuller's John H. Sprinkle 1, sw sw sw 20-2s-11w, ½ mi e extension	4- 6-49	2339	2331- 2339	McClosky li; Miss	P 24	....
Posey	Lamott	Joel Vail's W. E. Hill 2, sw sw sw 18-7s-12w, east extension	4-21-49	1942	1932- 1942	Tar Springs sd; Miss	P 62	....
		KANSAS—New Oil Fields						
Barton	.....	Bay Petroleum Co's Krone 1, sw sw sw 30-20-12w, 1 mi ne Rolling Green pl.	5-24-49	3551	3490- 3531	Arbuckle li; Ord	P 30	....
Butler	Hazlett, N.	Rex & Morris' Ammeter 1, sw se sw 30-23s-5e, 1 mi n Hazlett pl.	5- 2-49	2472	2461- 2472	Mississippi li; Miss	P 30	38
Ellsworth	Palacky	Ferrell Drilling Co's Rous 1, sw sw se 31-16s-10w, 1 mi e Karft-Prusa pl.	5-10-49	3394	3389- 3394	Arbuckle li; Ord	P 48	....
Rooks	Locust Grove	Sam K. Pack et al's Griebel 1, ne ne nw 8-7s-19w, 4 mi ne Alcona pl.	5-26-49	3456	3438- 3456	Arbuckle li; Ord	P 25; 50 wtr	25
Trego	Wakeeney, E.	Heller & B&R Drilling Co's Carpenter 1, se se sw 13-11s-23w, 1 mi e Wakeeney pl.	5-24-49	4050	3576- 3598	Lansing-K. C. li; Penn	P 51; 8 wtr	....
		KENTUCKY—New Oil Field						
Ohio	.....	J. M. Murphy-Geo Wakefield-T. R. McInturff's R. M. Hunt 1, 18-N-21, 1½ mi sw Bells Run pl.	5-25-49	995	971- 985	Jackson sd; Miss	P 28	....
		NORTH LOUISIANA—New Distillate Field						
Lincoln	.....	Southwest Gas Producing Co's W. J. Burgess 1, 1342 fr nl 1320 fr el 8-20n-4w, ¾ mi se Lisbon fld.	5- 7-49	9148	8680- 8700	Vaughn sd; Eoc	F 26; 1.7 mln; 24/64"	54.8
		NORTH LOUISIANA—New Distillate Pay						
Caddo	Caspiana	Phillips Petroleum Co's C. Ellerbe 1, 1880 fr sl 3330 fr el 17-15n-12w	5-19-49	9014	4450- 4570	Kilpatrick li; L. Cre	F 48; 2.2 mln; 14/64"	67.7

[1]Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian: U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2]Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in May, 1949

Also Important Extensions to Established Fields

CONTINUED

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		SOUTH LOUISIANA—New Oil Fields						
Acadia	.....	Callery & Hurt's Henry Goss 1, 2766.6 w 3312 n fr sec of 13-7s-1e, betw Bayou Malley & Bayou Mallet S fids.	5- 5-49	8755	4897- 8503	.....	F 184; 4/64"	36
Beauregard	Longville, E.	Barnsdall Oil Co's M. Jones 1, in nec 3-6s-9w, 3 mi e Longville pl.	5-17-49	8355	8320- 8336	Cockfield sd; Eoc	F 324; 4/32"	47.2
		SOUTH LOUISIANA—New Oil Pays						
Jefferson	Caminada Pass	Humble O&R Co's Caminada Pass St. Lse 804-D-1, Tr 1114, Blk 16 in Gulf of Mexico.	5-19-49	6380	6128- 6138	.....	F 53; 1/16"	29.7
Lafourche	Bay Marchand	The California Co's State Lease 1367-3, 5399 s 3907 w fr nec of Blk 3, in Gulf of Mexico.	4-30-49	5526	5048- 5092	.....	F 432; 4/32"	40
Pointe Coupee	Fordoche	The Texas Co's J. O. Long et al 2, 660 s 1980 e of nwc 29-6s-8e	5-26-49	10000	8197- 8207	.....	F 310; 4/32"	36.6
		SOUTH LOUISIANA—New Distillate Fields						
Cameron	.....	Stanolind O&G Co's State Lse 1133-1, 5997 w 330 n of sec Lse 1133, Tr 2362, being s½ Blk 45, 10 mi in Gulf of Mexico.	5-21-49	8814	8738- 8748	.....	F 40; 3.6 mln; 1/4"	51.5
Vermilion	.....	Superior Oil Co's Gulf of Mexico-State C-1, Blk 76, 19½ mi in Gulf of Mexico.	5- 1-49	11603	7415- 7430	.....	F 12; 7.6 mln; 4/32"	45.6
		SOUTH LOUISIANA—Distillate Field Extension.						
Beauregard	Gordon	T. G. Markley & Crosby Drlg Corp's Gimnick 1, 660 n 330 w of sec 27-6s-10w.	5-22-49	7015	6715- 6729	L Miocene	F 130; 3 mln; 1/4"	66
		SOUTH LOUISIANA—New Gas Pay						
Terrebonne	Bay Junop Dome	Union Oil Co's St. Lse 725-LL&E Unit 2-9, 1680 s 2540 w of nec 27-21s-14e.	5-14-49	4593	3493- 3498	.....	F 0.9 mln; 1/8"	....
		MICHIGAN—New Oil Fields						
Gladwin	"Bard"	W. L. McClanahan's Rhinehart 1, ne ne nw 6-17n-2w, Beaverton Twp, 4 mi w Beaverton fld.	5-20-49	3985	3930- 3944	Dundee li; Devo	P 50	40.6
Van Buren	.....	Harris Oil Co's Springett 1, w½ ne ne 5-1s-16w, Bangor Twp.	5-15-49	1057	1039- 1057	Traverse li; Devo	P 5	....
		MICHIGAN—Oil Field Extension						
Allegan	Lee	Max Spidel's Grover 1, nw sw se 18-1n-15w, ½ mi n&e extension.	5- 6-49	1180	1175- 1179	Traverse li; Devo	P 10; 5 wtr	....
		MISSISSIPPI—New Oil Field						
Adams	Ellisle	Sohio Pet Co, Hunter & Kemp Drlg Co's Geo. W. Armstrong 1, Sect 36-5n-3w, 7½ mi sw La Grange, S. fld.	5-23-49	6518	6465- 6469	Wilcox sd; Eoc	F 360; 4/16"	37
		NEW MEXICO—New Oil Fields						
Lea	"Knowles"	Amerada Petroleum Co's Hamilton 1, 1980 fr s&wl of 35-16s-38e, 10 mi e Lovington fld.	5- 4-49	12656	12518-12600	Devonian li; Devo	F 935; ½"	46.9
Lea	.....	Magnolia Petroleum Co's Betenbaugh 1, 660 fr s&wl of 12-9s-35e, 5 mi nw Crossroads Devonian fld.	5-12-49	9641	9617- 9635	Pennsylvania li; Penn	F 511; ¼"	50.2
		NEW MEXICO—New Oil Pay						
Lea	Langlie-Mattix	Stanolind O&G Co's S. Mattix Unit 1, 1980 fr s&el of 15-24s-37e, east flk of fld.	5-20-49	9705	9512- 9564	Ellenburger dolo; Ord	F 383; 4/16"	45
		OKLAHOMA—New Oil Fields						
Garvin	Robberson, SE	Tidewater Assoc. Oil Co's Henry Culplan 1, se sw se ne 31-1n-2w.	5-11-49	927	766- 780	Bromide sd; Ord	P 30	31
Grant	Renfrow, E.	Cities Service Oil Co's Pratt 1, ne se ne 6-28n-3w.	5-12-49	4978	4968- 4978	Wilcox sd; Ord	F 152; 14/64"	50
Lincoln	Agra, NW	Fordee-Rhoades & Texinia Corp's Colon 1-A, nw ne sw 28-17n-4e.	5- 5-49	4375	3802- 3850	U Bartlesville sd; Penn	P 12; 100 wtr	....
Pottawatomie	Red Hill	Davon Oil Co & Atlantic Ref Co's Santa Fe Gun Club 1, nw nw se 26-11n-4e	5- 5-49	5578	4787- 4817	Unconformity sd; L Penn	P 13	35.5
Seminole	Sylvian, E.	Sam A. King's E. R. Kelly 1, (OWWO), c sw ne 12-10n-7e.	5- -49	3621	3605- 3617	Union Valley sd; L Penn	P 45; 12 wtr	35
		OKLAHOMA—New Gas Field						
Hughes	.....	W. A. Delaney Jr's Long Heirs 1, ne ne ne 14-8n-9e, ¾ mi fr Long fld oil prod.	5- 5-49	3146	3130- 3145	Gilcrease sd; Penn	F 7.2 mln; open	....
		OKLAHOMA—New Gas Pay						
Hughes	Greasy Creek	Skelly Oil Co's Price 1, (OWWO), sw ne nw 26-8n-10e.	5-13-49	3495	2360- 2397	Booch sd; L Penn	F 1.2 mln	....
		TEXAS—District 2 (MIDDLE GULF)—New Oil Pay						
Bee	Mineral, N.	Rudco O&G Co & Rock Hill Oil Co's Mrs W. R. Boothe 1, 4400 fr nwl 467 fr swl of Asa Walker Sur, 934 n-nw of Rudco's disc well.	4-21-49	8261	7614- 7616	.....	F 76; 49 wtr; 7/64"	37
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Fields						
Bee	Maley	The Superior Oil Co's Mrs Celia Maley et al 1, 300 fr ne&nwl of AB&M Sur 3, 2 mi w Yoward fld.	5-18-49	8307	8100- 8112	Wilcox sd; Eoc	F 96; 1.9 mln; 4/32"	59.2
Live Oak	.....	Caroline Hunt Tr Est's J. S. Hall 1, 660 fr swl 1980 fr nwl of BS&F Sur 185, 7½ mi s George West.	5-14-49	5272	4318- 4326	.....	F 14; 0.7 mln; 4/16"	56
Live Oak	.....	Magnolia Petroleum Co et al's Block 85, Unit 1, 1898 fr nl 1980 fr el of Blk 85, Dr C. F. Simmons Sbdn, D. R. Fant Sur, 2¼ mi w-nw "Maxine" fld.	5- 6-49	8524	7845- 7879	.....	F 36; 4.6 mln; 4/16"	56.8
		TEXAS—District 2 (MIDDLE GULF)—Distillate Field Extension						
DeWitt	Brushy Creek	Shell Oil Co Inc's Mrs Lue Goode 1 ,2400 fr swl 3850 fr sel Chas. P. Delmas Sur, ⅔ mi extension.	5-21-49	7850	7719- 7751	Wilcox sd; Eoc	F 135; 4.7 mln; 4/16"	57.9
		TEXAS—District 2 (MIDDLE GULF)—New Gas Field						
Lavaca	.....	Hassie Hunt Est's R. L. Smothers 1, 3000 fr n'ly nl 1150 fr el of J. Chesher Sur, 3 mi s Speaks fld.	5-25-49	9330	3348- 3360	.....	F 14 mln; open	....
		TEXAS—District 3(UPPER GULF)—New Oil Field						
Tyler	Hicksbaugh	Humble O&R Co's Wm. Rice Institute 1-B, 330 fr sl 660 fr el Sect 5, T&NO Sur, 2½ mi e of S Hyatt fld.	5- 8-49	10500	8480- 8483	.....	F 51; 4/16"	39.6
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Brazoria	Manvel	Gulf Oil Corp's E. H. Colby et al 6, 200-ac Lse, Thos. Spraggins Sur.	5-24-49	5516	4040- 4060	Miocene sd	F 125; 4/32"	25.3
Fort Bend	Big Creek	The Texas Co's A. P. George 1-C, 25-ac Lse, B. Wickson Sur, s flk of fld.	5-16-49	4150	3720- 3730	.....	F 160; 4/32"	29
Jefferson	Stowell, N.	The Texas Co's Koch-Santa Fe 2, 1250 fr el 1875 fr nl of Lot 84, F. Valmore Lge.	5-25-49	6850	5444- 5450 5938- 5940	.....	F 17; 5.8. mln; 1/4"	Dist.
Tyler	Skillern	C. N. Housh's J. E. Wheat et al 1, 1000 fr nl 2400 fr wl BBB&C Sur.	5- 2-49	7688	7640- 7646	Wilcox sd; Eoc	F 286; 4/32" F 102; 4/16"	34.2 56
		TEXAS—District 3 (UPPER GULF)—New Distillate Field						
Montgomery	.....	Amerada Petroleum Corp's H. A. Godejohn 1, 330 fr n&wl of 34.2-ac Lse, M. B. Lawrence Sur, 3½ mi w Cleveland fld.	5- 5-49	13691	5620- 5628	Cockfield sd; Eoc	F 30; 2.4 mln; 4/16"	61
Waller	.....	The Texas Co's Wm. M. Rice Institute 1, 6850 fr nl 660 fr el John M. Stephens Sur, 5 mi w Magnolia fld.	5- 1-49	12561	10290-10304	Wilcox sd; Eoc	F 26; 4 mln open	49.4
Wharton	.....	R. J. Caraway's E. A. Weinheimer 1, 660 fr n&sl Frank Paige Sur, 5 mi nw El Campo.	5- 8-49	5405	5219- 5224	Basal Frio sd; Olig	No gge; 4.1 mln; 1/4"	....
Wharton	.....	Federal Royalty Co & R. A. Welch's Myra S. Pryor 3, 1427.5-ac Lse, Wm. Robinson Sur, 6 mi se New Taiton.	5-14-49	10834	10280-10834	Wilcox sd; Eoc	F 70; 3/8 mln; 1/4"	45.2
		TEXAS-District 3 (UPPER GULF)—New Distillate Pays						
Austin	New Ulm	Sinclair Prairie Oil Co's W. A. Schweke 1, Tract "A", 800 fr nwl 787 fr sel 2000 fr nel James Tylee Sur.	5-19-49	10013	9225- 9235	L Wilcox sd; Eoc	F 201; 11 mln; open	56.7
Hardin	Beach Creek, E.	American Republics Corp's C. M. Votaw Fee 1, (OWDD), 678 fr wl 1800 fr sl Sect 200, C. M. Votaw (H&TC) Sur.	3-30-49	6468	6464- 6468	Yegua sd; Eoc	No gge; 4.2. 1/4"	....
Hardin	Village Mills, W.	Houston Oil Co's Houston Oil & American Republics Fee 1, (OWWO), 330 fr wl 2598 fr sl Wilbur Cherry Sur.	5- 1-49	7300	6845- 6855	.....	No gge; 3.2 mln; 1/4"	....
Orange	Gist, S.	Houston Oil Co's Newton Co Lumber Co. 1-A, 330 fr nl 680 fr el J. Collier Sur.	5-12-49	7650	7326- 7332	.....	F 20; 4.7 mln; 1/4"	....
		TEXAS—District 4 (LOWER GULF-SW)—New Oil Fields						
Duval	Chiltipin, N.	W. L. Goldston's Ed. Canales 2, 330 fr nel 850 fr sel SA&MG Sur 2, 1 mi nw Chiltipin fld.	4-19-49	4706	4151- 4155	Hockley sd; Eoc	F 101; 1/8"	44
Duval	.....	M. L. Massingill & American Republics Corp's Brigidia Garcia 1, 467 fr e&nwl of AB&M Sur 412, ¾ mi w Chiltipin fld.	5- 5-49	4883	4630- 4634	Pettus sd; Eoc	F 4; 76 wtr; 1/8"	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine ;cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian: U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

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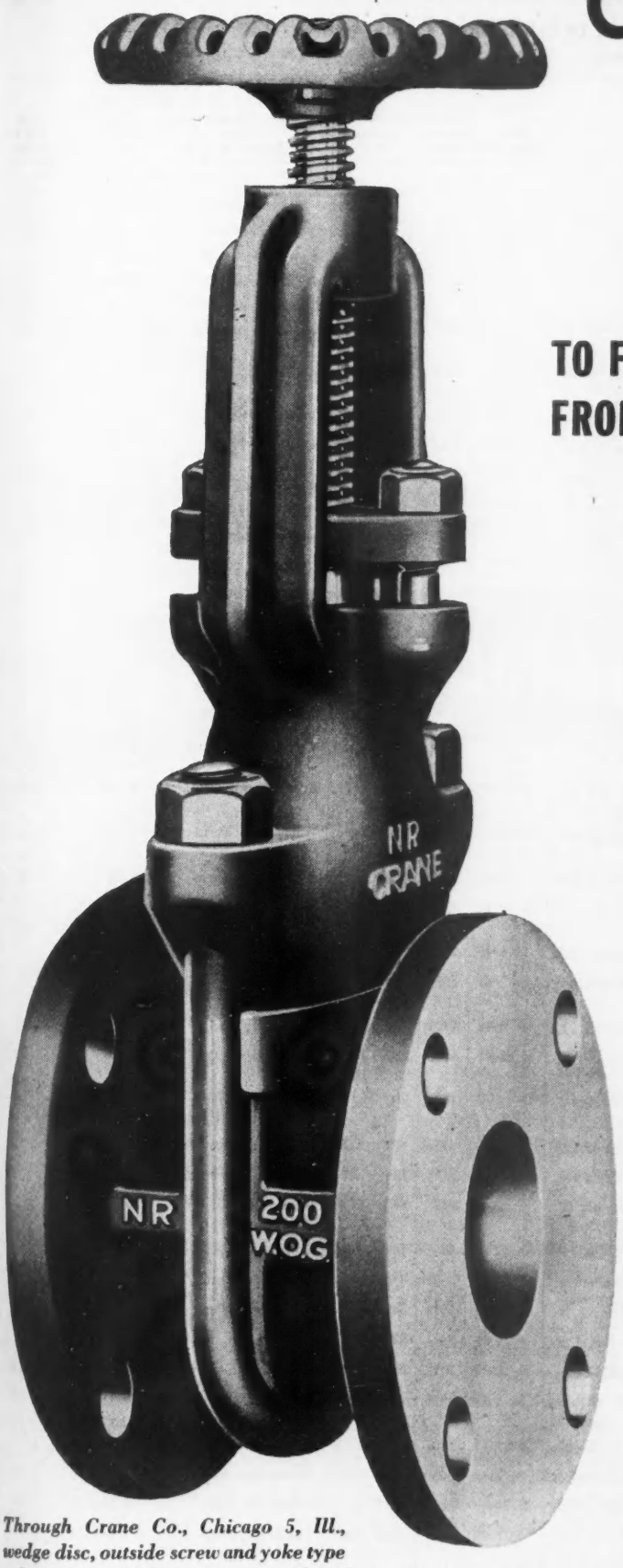

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New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in May, 1949

Also Important Extensions to Established Fields

CONTINUED

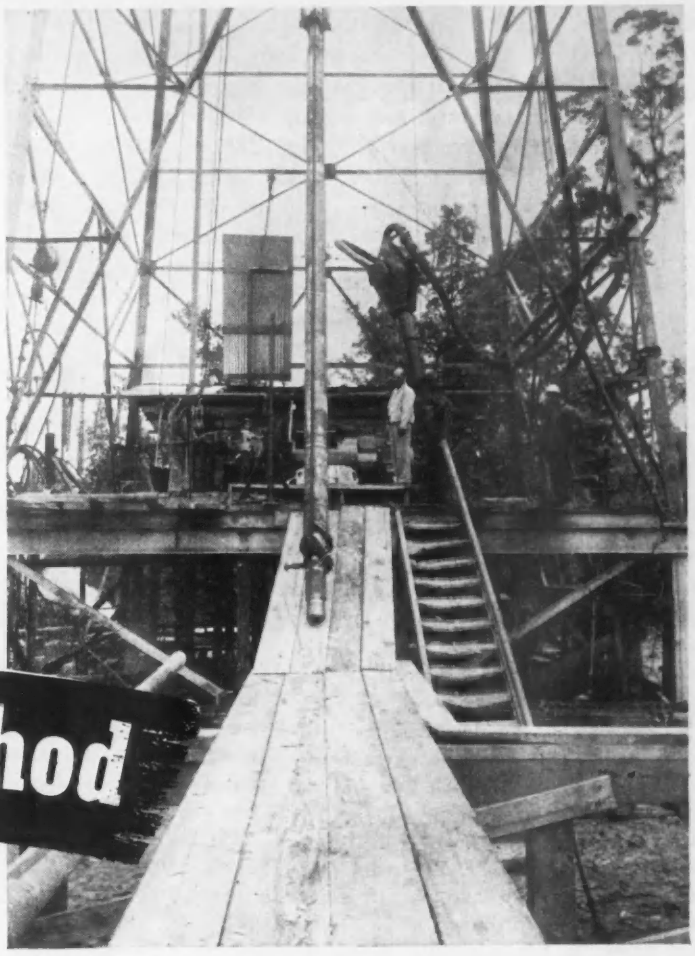
COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		TEXAS—District 4 (LOWER GULF SW)—New Oil Pays						
Brooks	Alta Mesa, E.	L. M. Lockhart's Adolfo Garcia 1, 1980 fr wl, 11,100 fr nl La Encantada Gr, 1¼ mi n of prod.	5-21-49	6515	3850- 3855	Mesa sd; Olig	F 106; 2/64"	45.2
Duval	Kohler, S.	Rodney DeLange's J. T. Dinn 3, 330 fr sl 2114 fr wl J. Poitevent Sur 454	4-17-49	1814	1808- 1811	Cole sd; Eoc	P 17; 9 wtr	19
Jim Wells	Alfred	Morris Cannan's O. S. Adams 1, 590 fr sl 1826 fr el Wm. Adams Sur. 5	5-17-49	5111	4575- 4581		F 43; 2/64"	44
Kenedy	Sarita	Humble O&R Co's John G. Kenedy, Jr 6-B, (OWWO), 1980 n 4620 e fr sec Blk 12, Kenedy Pasture Co. 1st Addn to Sarita Twp.	4-29-49	8838	6867- 6973		P 57; 86 wtr	41
San Patricio	Plymouth, E.	G. C. Glasscock's E. N. Tutt 1, 330 fr n&el of 120-ac Lse, Sect 26, 4th Addn of Taft Fm Lds.	5- 3-49	5497	5446- 5454		F 168; 2/64"	29.3
		TEXAS—District 4 (LOWER GULF-SW)—New Distillate Pay						
Duval	Charamousca-Wilcox	Magnolia Petroleum Co's Drought 1-A (OWWO), 330 fr n&el of s½ of J. L. Saenz Sur 154.	5-16-49	8504	5953- 5974		F 8; 1.8 mln; 4/16"	55.8
		TEXAS—District 6 (NORTHEAST)—New Oil Pay						
Rusk	Henderson, S.	Chicago Corp's C. G. Rayford 1, (OWWO), 7000 fr wl 5200 fr sl James Smith Sur.	5-20-49	7518	7237- 7243	L. Pettit li; L. Cre	F 26; 3/8"	40
		TEXAS—District 7-B (N. CENTRAL)—New Oil Fields						
Haskell		American Liberty Oil Co & Geo Rice et al's C. T. Jones 1, 990 fr s&wl Sect 26, Blk 46, H&TC Sur, 6 mi e Weinert.	5-18-49	5860	5514- 5545	Bend cgl; Penn	P 17	42
Haskell		Humble O&R Co's C. G. Burson et al 1, 1200 fr el 467 fr nl J. Korus Sur, Blk 12, 8 mi sw Weinert.	5-18-49	6031	4735- 4755	Strawn sd; Penn	F 151; 4/16"	38.8
Haskell		Thos. D. Humphrey's E. O. Chapman 1-A, 2260 fr el 2355 fr sl H. Tidwell Sur 60, 6 mi ne Haskell.	5-29-49	2534	2496- 2520		P 19	38.8
Jones		S. B. Roberts and The Eastland Oil Co's W. L. Chittenden Est 1, 330 fr s&wl of Sbdn 5, Lge 336, McMullen & McGloin Sur, 1 mi sw Radium	5-10-49	3015	3010- 3015	Swastika sd; Penn	P 97	38
Nolan		G. H. Brodie & Hunt Oil Co's J. P. Aycock 1, 660 fr s&wl of ne¼ Sect 58, Blk 21, T&P Sur, 4 mi se Sweetwater.	5-20-49	6166	6150- 6166	Ellenburger li; Ord	P 15; 135 wtr	45
Shackelford		Langford & Miller et al's J. H. Grimes 1, 1200 fr el 150 fr sl Sect 87, Blk 12, T&PRR Sur, 10 mi n Baird.	5- 9-49	1334	966- 982		P 5; 28 wtr	38
Throckmorton		Fred M. Manning Inc's A. E. Nash 1, 467 fr nl 2447 fr el Sect 248, BBB&C Sur, 3 mi sw Throckmorton.	5-25-49	4987	4895- 4904	Bend cgl; Penn	F 126; 2/64"	41
Throckmorton		Jas. H. Snowden et al's Norton Heirs 1, 330 fr nl 850 fr wl of Sect 2315, TE&L Sur, 7 mi ne Woodson.	5-17-49	4630	4621- 4630	Mississipp ili; Miss	F 795; ½"	41.8
Throckmorton		Woodley Petroleum Co's Henry S. Bryson 1, 1008 fr nl 369 fr el Sect 911, TE&L Sur, 3 mi sw Woodson.	5-11-49	4632	4599- 4659	Mississippi li; Miss	F 152; 4/32"	....
		TEXAS—District 7-B (N. CENTRAL)—New Oil Pays						
Callahan	Admiral	Star Oil Co's Mrs. C. Smith 1, 660 fr nl 1890 fr el Sect 45, D&DA Sur, 3 mi se Admiral.	5-22-49	1981	1920- 1938	Cross Plains sd; Penn	F 142; 3/8"	....
Stephens	Unnamed	McElroy Ranch Co's B. G. O'Neal 1-B, 334 fr sl 456 fr wl of J. H. Garrett Sur.	5-18-49	4480	3249- 3255	Caddo li; Penn	F 116; 1/4"	41.5
		TEXAS—District 7-B (N. CENTRAL)—Oil Field Extension						
Stephens	Unnamed	McElroy Ranch Co's B. G. O'Neal et al 1, 2400 fr sl 1263 fr wl Sect 3, Blk 8, T&P RR Sur, ¾ mi extension.	5- 3-49	4474	4460- 4474	Ellenburger li; Ord	F 109; 11/64"	44.2
		TEXAS—District 7-C (W. CENTRAL)—New Oil Pay						
Reagan	Benedum	Plymouth Oil Co's W. H. Dixon 1-2, 660 fr nl 2526 fr wl Sect 2, Peter Beach Sur 2, 1¾ mi se of disc well.	1-29-49	11354	7390- 7430	Wolfcamp li; Perm	P 19	38
		TEXAS—District 7-C (W. CENTRAL)—Oil Field Extensions						
Crockett	Tippett	Standard Oil Co. of Texas' J. H. Tippett 3-38, 440 fr ne&sel Sect 38, Blk 31, H&TC Sur, 3200-ft nw extension.	2-12-49	6273	6228- 6250	Wolfcamp li; Perm	F 294	40.4
Tom Green	Susan Peak	J. K. Wadley, R. T. Adams & Louis Burns' J. Wiley Green 1, 330 fr n&wl Sect 195, Dist 11, SPRR Sur, 1 mi e extension.	5-10-49	4725	4676- 4723	Strawn li; Penn	F 227; 1/4"	34
		TEXAS—District 7-C (W. CENTRAL)—New Gas Fields						
Crockett		Fred Turner's Shannon Estate 1, 660 fr n&wl of sw¼ Lge 3, Archer CSL Sur, 1½ mi ne Noelke fld.	1- 1-49	2150	2125- 2150	San Andres sd; Perm	F 10 mln	....
Runnels		E. P. Griffin's Bryan Clayton 1, 990 fr sl 1320 fr wl Sect 138, ETRR Sur, 11 mi ne Ballinger.	5-17-49	3972	3800- 3817	Gardner sd; Penn	F 2.9 mln; open	....
		TEXAS—District 8 (WEST)—New Oil Fields						
Scurry		J. L. Collins et al's G. E. Parks 1, 1980 fr nl 330 fr wl Sect 442, Blk 97, H&TC Sur, 1¼ mi e of N Snyder-Canyon fld.	5- 5-49	7322	7308- 7322	Strawn sd; Penn	F 492	38
Scurry		Humble O&R Co's B. A. Moore 1-B, 1880 fr nl 1980 fr el Sect 492, Blk 97, H&TC Sur 2 mi nw of N. Snyder-Canyon fld.	5-25-49	8405	8200- 8240	Ellenburger li; Ord	P 47	46.5
		TEXAS—District 8 (WEST)—New Oil Pay						
Crane	Univ-Waddell Ellen	Gulf Oil Corp's Texas Consolidated 4-D-HH, 1980 fr el 667 fr sl Sect 3, Blk 31, Univ Lds Sur.	5-11-49	11080	9023- 9100	Devonian li; Devo	F 520; ½"	39.9
		TEXAS—District 8 (WEST)—Oil Field Extesions						
Andrews	Parker, W.-Devonian	The Texas Co's State of Texas 1-W, 1989 fr nl 665 fr el of n½ Sect 35, Blk 12, Univ Lds Sur, 1½ mi n extension.	5-17-49	8450	8310- 8358	Devonian li; Devo	P 25; 23 wtr	38.3
Pecos	Yates	Jessie Russell's Helmerich & Payne 1, 1054 fr nl 1650 fr el Sect 1, Blk 194, GC&SF Sur.	3- 2-49	1431	1366- 1377	San Andres li; Perm	P 32	30
Scurry	Kelly	Magnolia Petroleum Co's A. B. Eicke 1, 660 fr s&wl Sect 209, Blk 97, H&TC Sur, 1½ mi extension.	5-16-49	6778	6770- 6778	Canyon Reef li; Penn	F 166; 4/64"	....
		TEXAS—District 9 (NORTH)—New Oil Fields						
Archer		A. R. Dillard's Nick Schenk 2, 2333 fr sl 467 fr wl Lot 20, Blk 3, Clark & Plumb Sbdn, ½ mi e Scotland.	5-24-49	4655	4626- 4645		P 19; 5 wtr	....
Archer	Archer Co. Reg.	W. J. & J. J. Moran's W. R. Hammond 2, 660 fr el 990 fr sl H. Corzine Sur, 3 mi se Chalk fld.	5-20-49	3859	3856- 3859	Strawn sd; Penn	F 336; 1/4"	42
Jack		Jack Grace Production Co's Edgar G. Brown 1, 1430 s 467 w of nwc I. N. Adair Sur in J. M. Hudson Sur, 10 mi n Jacksboro	5-17-49	5512	5454- 5512	Caddo cgl; L Penn	F 203; 4/64"	48
Montague		S. D. Johnson's H. D. Field 1, 990 fr nl 330 fr wl E. Peddycoart Sur, 4 mi n St Jo.	5-31-49	2284	2266- 2284		P 147; 96 wtr	....
Wichita		W. H. Hammon's Fassett & Tuttle 1-C, 330 fr n&el of Blk 23, K&N Sbdn, Cherokee CSL Sur, 2½ mi ne Airport fld.	5-12-49	5318	5303- 5318	Caddo li; Penn	F 1221; 3/8"	44
Young		Signal O&G Co. & Rankin's G. D. Hunt et al 1, 1300 fr nl 330 fr wl P. B. Hunt Sur, 4 mi ne Allar fld.	5- 8-49	4637	4622- 4636	Mississippi li; Miss	F 188; 4/64"	43
		TEXAS—District 9 (NORTH)—New Oil Pays						
Archer	Hunter Bros.	Mora Drilling Co's T. B. Wilson 1-A, 330 fr nl 990 fr wl of se¼ S. P. Ellis Sur	5-28-49	3821	2796- 3821	KMA sd; Penn	F 273; 1/2"	43
Clay	Acme	S. D. Johnson's W. I. Holt 1-B, 1900 fr wl 3450 fr sl T. Morehead Sur.	5- 4-49	5770	5730- 5770	Mississippi li; Miss	F 411; 1/2"	46.3
Jack	Post Oak	Mid-Continent Pet Corp's W. N. Killeen 2, 330 fr nl 990 fr wl B. Lewis Sur	5- 7-49	6290	6240- 6258	Ellenburger dolo; Ord	F 316; 2/64"	45
		TEXAS—District 9 (NORTH)—Oil Field Extensions						
Archer	Medders-Hancock	W. J. & J. J. Moran's Wm McGregor 1, 2173 fr wl 1784 fr sl Sect 4, Blk 1, H&TC Sur, 1¾ mi se extension.	5-20-49	3878	3867- 3878	Strawn sd; Penn	F 530; 1/4"	43
Jack	Chico	C. G. Glasscock & Pontiac Ref. Co's R. L. Morris 1, J. U. Fields Sur, 2 mi w extension.	5-21-49	5504	5413- 5426	Caddo cgl; Penn	F 480; 3/4"	43.2
		TEXAS—District 9 (NORTH)—New Gas Field						
Wise		R. B. Thrift's C. A. Laurence 1, 330 fr most s'ly s&el J. B. Patterson Sur, 2½ mi s Chico fld.	5-17-49	5615	5337- 5404	Caddo cgl; L. Penn	F 3.2. mln; 4/64"	....
		WYOMING—New Oil Field						
Johnson		Continental Oil Co's Unit 5, se sw nw 23-42n-78w, 3 mi se Sussex fld.	5-25-49	7485	7459- 7485	Lakota sd; L. Cre	F 264; 4/32"	42
		WYOMING—Oil Field Extension						
Weston	Skull Creek	Parker & Simmons' Gov't Wright 1, sw ne sw 24-44n-62w, 1 mi se extension	5-21-49	2940	2934- 2940	Newcastle sd; U Cre	P 100	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

UTILIZING HYDRAULIC POWER through the medium of pressurized mud in the drill string to rotate the bit, a streamlined turbine develops the necessary torque while using the stationary or slowly rotating drill string as backup. The system uses the conventional drill string and is operated with pipe in tension, weight on the bit being provided through collars as with rotary-table drive. Bit speeds are about three times those used with table drive. The author cites well performance data.

Drilling by the Turbine Method



Turbodrill going onto derrick floor.

By CRITCHELL PARSONS
President
Engineering Development Company

IN TURBINE drilling hydraulic power, derived from the circulation of conventional drilling fluid through a turbine at the bottom of the regulation drilling string, is utilized to drive the bit instead of mechanical power applied at the rotary table and transmitted through the drilling string to the bit. The turbodrill is made up in the string immediately above the bit, and the drilling drive shaft rotating in the hole is only a few feet long instead of being as long as the hole is deep.

Turbine drilling provides an efficient and safe means of power transfer from the surface to the bottom of the hole, and in terms of horsepower per square inch on the formation has an advantage, which increases with depth, over the rotary. Useful work must steadily diminish as the hole goes down in rotary drilling, whereas in turbine drilling it can be kept constant from top to bottom.

The Edco Turbodrill, as developed after a number of years of research and experimentation, is designed for heavy duty drilling as a general substitute for the rotary. The large model, which is designed for use with 5-9/16- or 6⅝-inch drill pipe, has 90 turbine stages, an outside diameter of 9¾-inch, weight of 8000 pounds, length of thirty feet, and a rated input capacity of 900 gpm of fluid. At this fluid volume it will deliver to the bit approximately 300 horsepower at a drive shaft speed (i.e. bit speed) of 450 revolutions per minute. Under development is a 6¾-inch outside diameter model which will weigh about 4000 pounds and operate on 400 gallons per minute to deliver 75 hp to the bit at 450 rpm. The drill pipe size for the smaller tool is 4½-inch. For adequate clearance in the hole it is recommended that nothing smaller than a 12¼-inch bit be run on the large tool, and 8¾-inch on the small one.

Fully Interchangeable

Turbine drilling is fully interchangeable with rotary drilling. For a 10,000-foot drilling operation with the 9¾-inch turbodrill, a heavy rig equipped with two 18x7¾x20-inch steam mud pumps, or their power pump equivalent, a 10,000-foot string of 6⅝-inch or 5-9/16-inch drill pipe, and six 30-foot lengths of eight-inch OD drill collar should be selected. These six drill collars will permit carrying, if found necessary, 30,000 pounds on the bit with the drill pipe entirely in tension. Conventional 12¼-inch, or larger, rock bits of the type suited to the formations to be penetrated are required. A shale shaker should be provided, and if mud tanks are not used the pits should be arranged to give at least as much settling time for the separation of sand and cuttings from the mud as is afforded under the best rotary mud practice. The use of a desander with the turbodrill is desirable, but not necessary. If solids large enough to block the fluid passages of the turbodrill are removed from the mud, normal quantities of sand do no damage to the turbine. If large solids are present in the mud, time will be lost in cleaning the protective devices carried in the string to exclude these solids from the tool itself.

The rig should be equipped with a bottom-hole weight indicator, since it is important in turbine drilling to carry a

steady load on the bit and not permit drilling off. Weight variation causes a variation of turbine and bit speed, which is undesirable. Experience has shown that a steady bit load is best achieved by using a weight indicator which gives the driller a positive bottom-hole weight reading at all times.

It is further recommended that a rat-hole be provided for the turbodrill in addition to the kelly rat-hole. The change from turbine to rotary drilling, for coring or other purposes, is accomplished simply by taking the turbodrill off the end of the string. This is no more involved than a bit change if a rat-hole is available to obviate the necessity of setting the turbodrill back in the derrick, or laying it down on the rack.

The first drilling operation with the Edco Turbodrill, which was carried out several months ago by Spartan Drilling Company of Dallas in the Salem Church field, Union County, Arkansas, is described here.

A heavy steam rig designed for drilling to 10,000 feet, and the extra heavy duty turbodrill of 10¼-inch OD and 900 gpm rated capacity, designed for use with 5-9/16-inch or 6⅝-inch drill pipe and large mud pumps were used. The purpose of the first test was to determine drilling performance at less than rated power in the generally unconsolidated formations which are present down to 1500 feet in the area, adaptability of personnel, standard rotary equipment and normal rotary mud practice, and durability of the tool itself. For this purpose it was deemed adequate to use smaller pumps, and because larger drill pipe was not available without delaying the operation, 4½-inch drill pipe was used. With this drill pipe and the one 16¼ x 7¾ x 20-inch steam pump used throughout, maximum power developed was 25 percent of rated, average throughout the turbodrilled section 20 percent, and 15 percent at the end of the section. It is necessary to consider the penetration rates given below in the light of the power limitations of the first turbodrill run.

The rig was equipped with a bottom-hole weight indicator and a geolograph. Electric logs, photoclinometer and caliper logs were run after the turbodrilled section was completed.

After surface hole was drilled by conventional rotary with a 20-inch rock bit to 167 feet, 16-inch conductor pipe was set and the plug was drilled to a total depth of 182 feet by conventional rotary with a 13¾-inch rock bit. At this point the turbodrill was made up in the string with no drill collars above and a 13¾-inch three-nozzle, tricone rock bit for unconsolidated, broken and medium rock formations was attached to the bit sub.

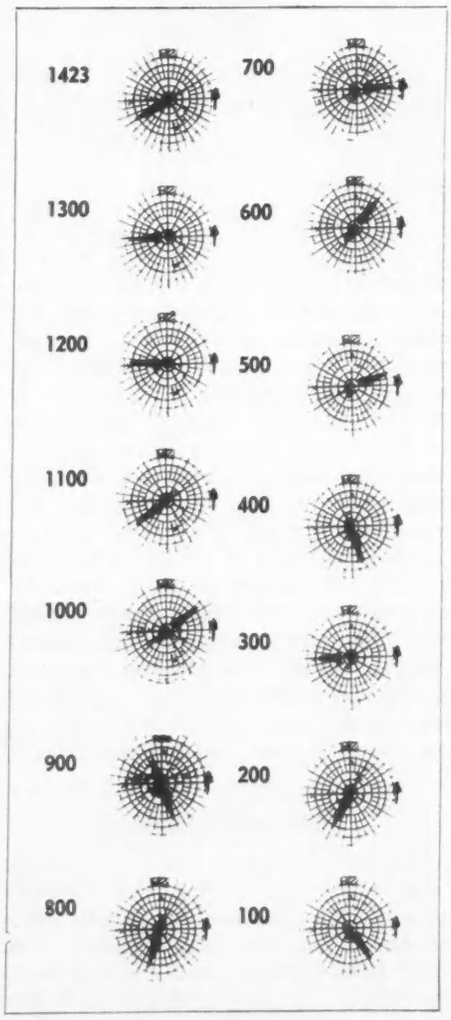
It was considered necessary to rotate the drill pipe at 10-15 rpm as a safeguard against channeling of the hole wall and sticking of the drill pipe. This turning rate was generally maintained throughout the run and there was no evidence of sticking at any time, although the table was not turned at all for considerable periods during the run.

The initial mud circulation rate was 560 gpm with a floor-gauge pressure of 775 psi. At 1132 feet total depth, the end of the turbodrill run, the circulation rate had fallen to about 400 gpm and the floor-gauge pressure was up to 875 psi.

Drilling Progress

The first 31 feet of hole were made in 10 minutes, and in the first hour of elapsed time 93 feet were made. In the first five hours of elapsed time 465 feet were made, with 124 feet in the fifth hour and a maximum penetration rate for one joint of drill pipe of 372 feet per hour was achieved, also in the fifth hour, when 31 feet of pipe were put down in five minutes.

At the beginning of the sixth hour of operation, a hard lime streak six feet thick was drilled which required 22 minutes to penetrate. Analysis of cuttings from this streak and others of a total thickness of 30 feet, requiring a total of 60 minutes to drill, indicated a hardness comparable to medium hard limestone. There was no vibration on the derrick floor, or drill pipe bouncing, at any time, but in the harder drilling the rotary table drifted backwards when released and the kelly was held very tight in the rotary by reactance from the turbine.



Deviation Survey

At the end of the tenth hour of elapsed time from the start of the turbodrill run 836 feet of hole had been made. Time was distributed as follows: 70 minutes for mud-pump and water-well repairs, 192 minutes for 27 connections, and 338 minutes on the formation drilling, or a rate of 2.47 feet of hole per minute while on the bottom. Over-all elapsed time drilling rate for the ten hours was 1.4 feet per minute.

The formations penetrated in the run were sand, sandy shale, medium shale, boulders and hard lime streaks. Maximum hole drift for any 100-foot section was one-quarter of a degree and over-all drift was one-sixth of a degree for 950 feet. Average weight carried on the bit was 7500 pounds, putting average neutral point about 30 feet above the bit, and average mud rate was slightly less than 500 gpm. From shop test power and speed data on the tool, it is calculated that an average of 60 hp, or 20 percent of rated maximum, was applied by the turbine to the bit, and average bit speed was 375 rpm with a minimum of 200 and maximum of 500 rpm. Stall load was 18,000 pounds on the weight indicator. String neutral point while drilling was in the turbodrill itself, i.e. less than 35 feet from the bottom, with the drill pipe entirely in tension at all times except momentarily when stall load was checked.

The caliper log shows that the hole was full-gauge and of uniform diameter practically throughout with a maximum diameter of 16¼-inch and average of 14½-inch, and no formation washouts.

One bit was used and it was in excellent condition after the turbodrill run. There was no damage to the bit teeth and the cones were tight. As mentioned above, the average bit load was 7500 pounds and average bit speed 375 rpm. Rotary practice in comparable digging in the area would be to carry an average load of 20,000 pounds and turn the bit at an average speed of 125 rpm.

Experience in the field indicates that the proper technique in turbine drilling is to maintain constant mud volume throughout the operation, and obtain maximum penetration speed through a given formation by determining opti-

Wilson

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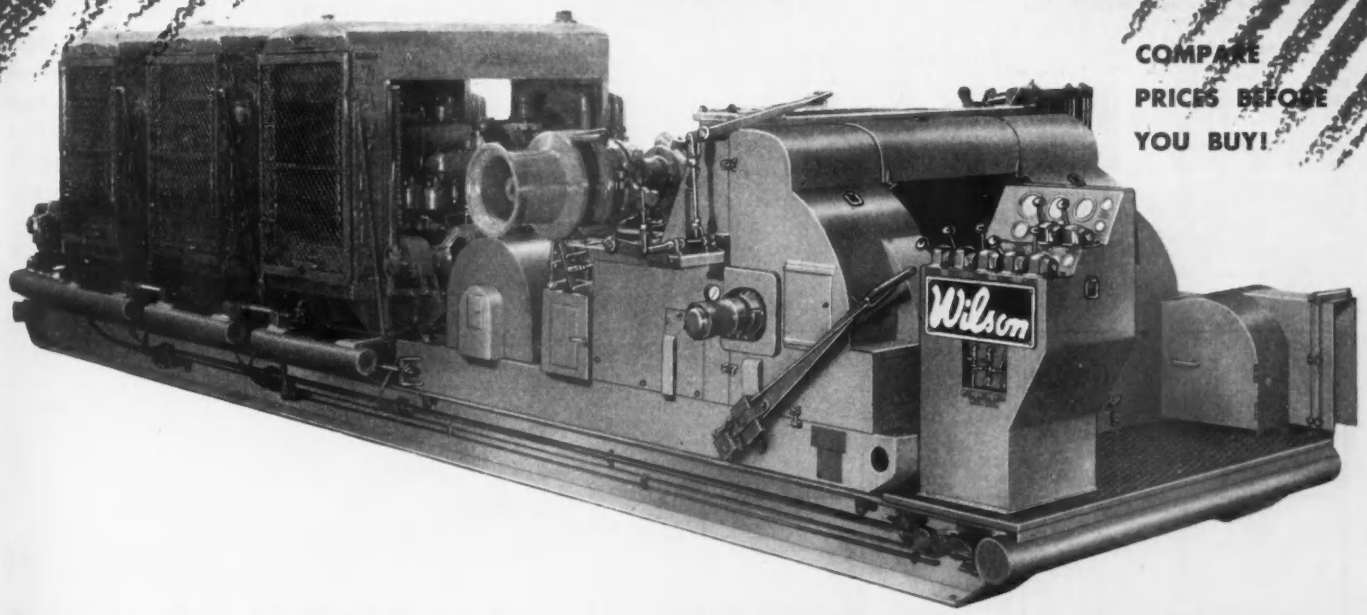

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RATED CAPACITY:

7500 ft. with 4½" drill pipe
9000 ft. with 3½" drill pipe

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mum bit load and maintaining this load by careful feed control. Bit speed over the range between stall and runaway speed is inversely proportional to bit load at constant fluid volume. Thus, from shop test data, it is calculated that the 9¾-inch turbodrill receiving 600 gpm of mud will turn the bit at 350 rpm with a bit load of 14,000 pounds.

Sand content of the mud during the run was held slightly below the average for rotary drilling by providing extra settling pits. Maximum content was 6 percent and minimum 0.5 percent, with a probable average of about 1 percent. Inspection of the turbodrill after complete disassembly revealed no evidence of sand abrasion or fluid erosion on any part and no damage to thrust or radial bearings.

At the end of the turbine drilling run, rotary drilling was resumed with a 13¾-inch rock bit of the same type as used on the turbodrill, for 286 feet to total depth of 1418 feet, where 9⅝-inch intermediate casing was run. The formations penetrated were of the same general nature, but somewhat less drillable than the turbodrilled section above. The elapsed time penetration rate for the rotary was 0.64 feet per minute and 0.82 feet per minute while on the bottom drilling.

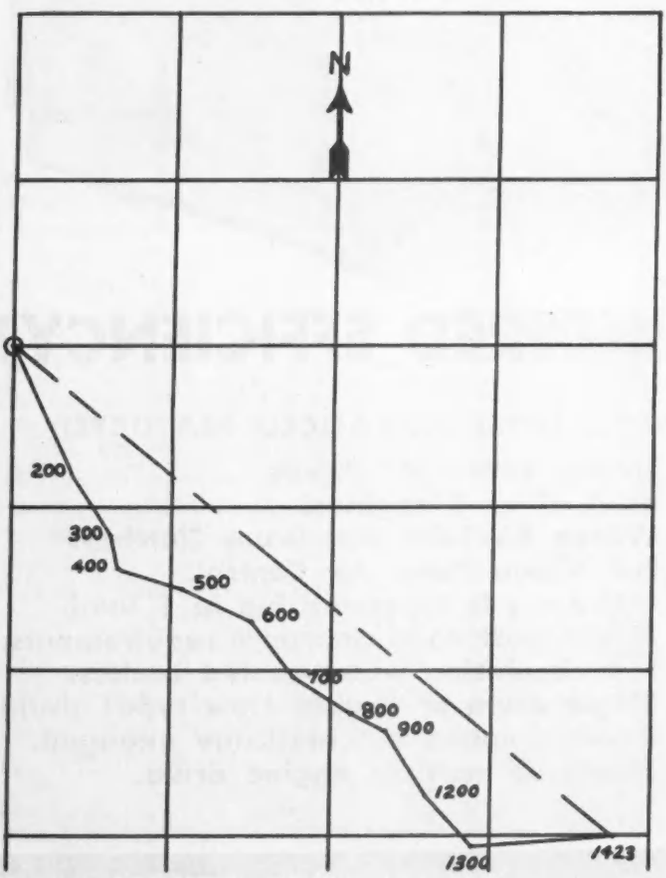
A complete comparison of rotary and turbine drilling rates could not be made under the conditions of the first run. Analysis of drilling records for other wells in the area, examination of cuttings from this well, and opinion of toolpushers and drillers familiar with rotary performance in southern Arkansas indicate that the turbodrill penetration rate on its maiden run, at one-fifth of full power and operated by drillers with no previous experience in the turbine drilling technique was 50 to 75 percent higher than the normal rotary rate. As mentioned above, drift was only one-sixth of a degree from top to bottom, the hole was full-gauge and of uniform diameter practically throughout, and was drilled without vibration on the derrick floor. Stress and wear on the drill pipe, swivel and rotary were greatly reduced, and standard rotary surface and subsurface equipment was used with nothing additional except the turbodrill itself.

With a 9¾-inch turbodrill operated by an experienced driller, 6⅝-inch (5.965-inch ID) drill pipe and 12¼-inch tricone rock bit, two 18x6¾x20-inch mud pumps delivering 800 gpm of fluid, 10,000 pound bit load, rotary table speed of 10-15 rpm, drill pipe connection time of five minutes per joint, and down time allowance of 10 percent of total time, it is calculated that the first 1000 feet of hole, from the bottom of the conductor pipe through formations of similar drillability to those penetrated on the first

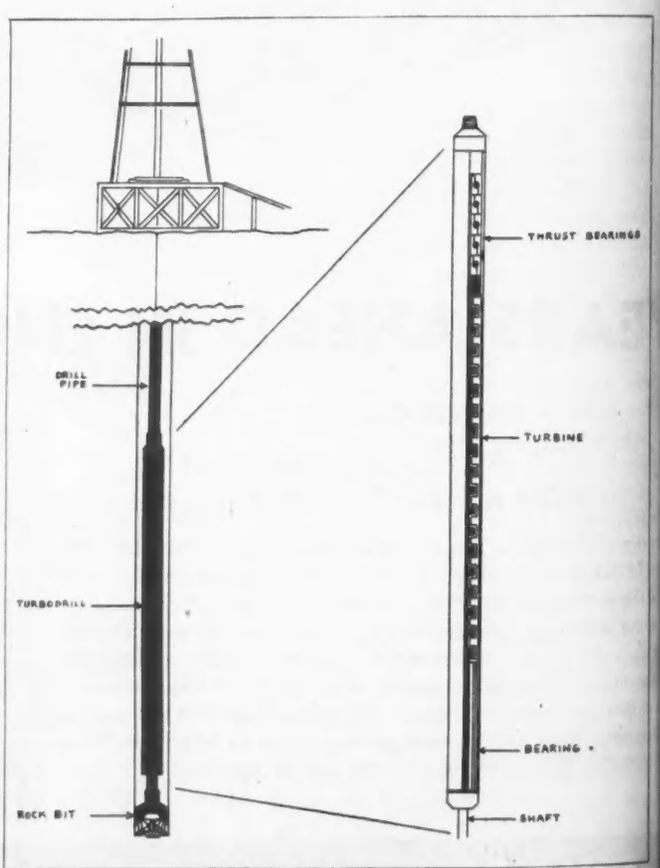
Table of Observed Bottom Hole Positions

DEPTH	Drift Angle	DEFLECTION			LATITUDE		DEPARTURE		COORDINATES			
		True Bearing	Horizontal Footage	Vertical Footage	N	S	E	W	N	S	E	W
100	¼	.....	.44	....	....	....	....	....	....	....	....	....
200	½	S-25E	.87	....	....	.79	.37	....	....	.79	.37	....
300	¼	S-30E	.44	....	....	.38	.22	....	....	1.17	.59	....
400	⅛	S-25E	.22	....	....	.20	.09	....	....	1.37	.68	....
500	¼	S-65E	.44	....	....	.18	.40	....	....	1.55	1.08	....
600	¼	S-70E	.44	....	....	.15	.41	....	....	1.70	1.49	....
700	¼	S-40E	.44	....	....	.33	.28	....	....	2.03	1.77	....
800	¼	S-55E	.44	....	....	.25	.36	....	....	2.28	2.13	....
900	⅛	S-65E	.22	....	....	.09	.20	....	....	2.37	2.33	....
1000	..	.....	....	....	....	....	....	....	....	2.37	2.37	....
1100	..	.....	....	....	....	....	....	....	....	2.37	2.37	....
1200	¼	S-30E	.44	....	....	.38	.22	....	....	2.75	2.59	....
1300	¼	S-45E	.44	....	....	.31	.31	....	....	3.06	2.90	....
1423	½	N-87E	.97	....	.05	....	.87	....	....	3.01	3.77	....

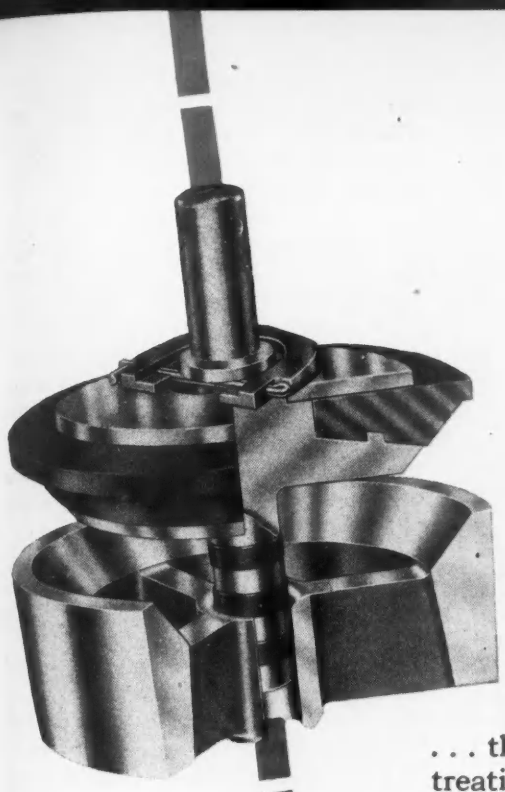
Bottom of hole lies 4.8′ S., 38° E. of bottom of 16″ surface casing.



Charted bottom hole positions.



Diagrammatic sketch and method of mounting turbodrill.



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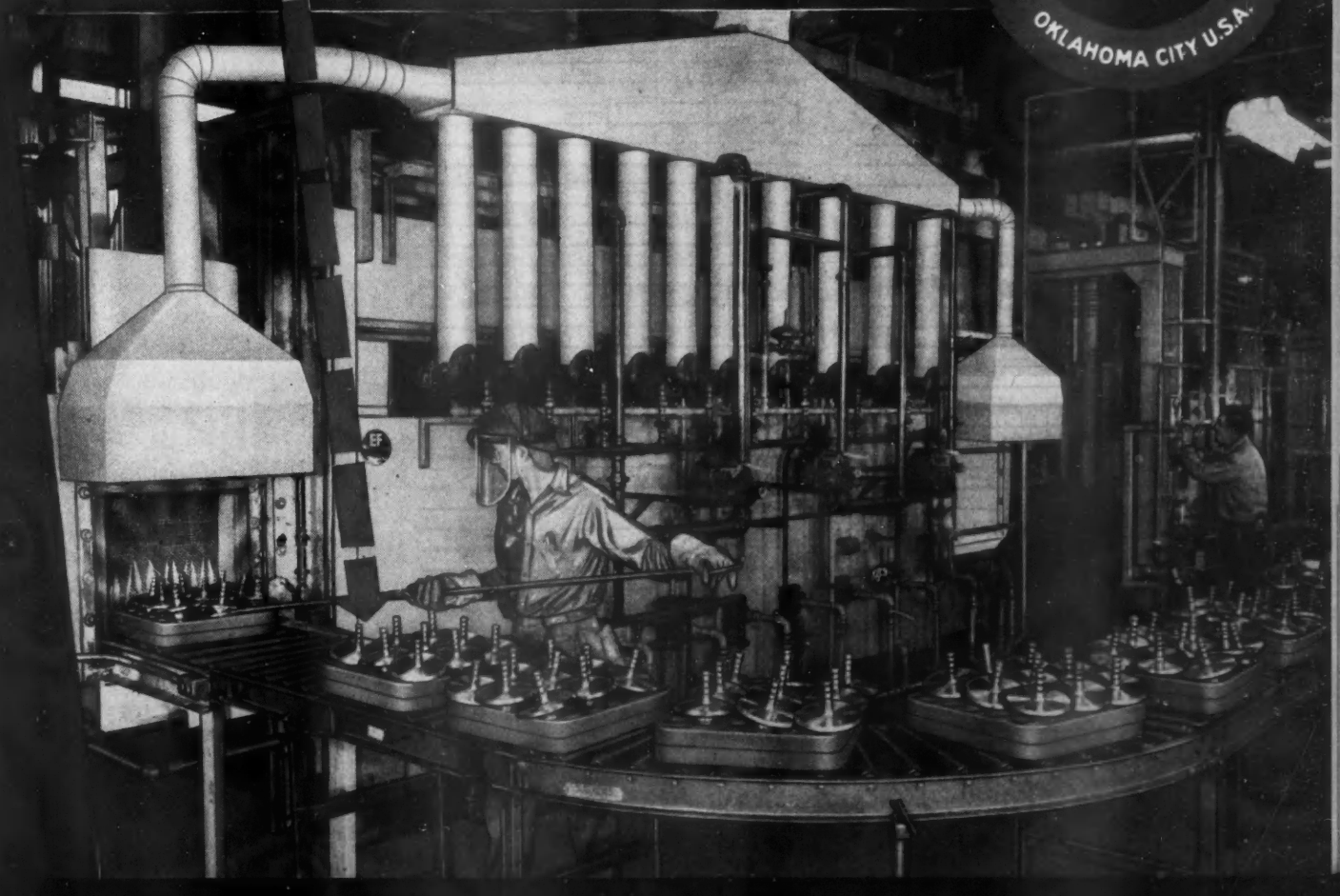
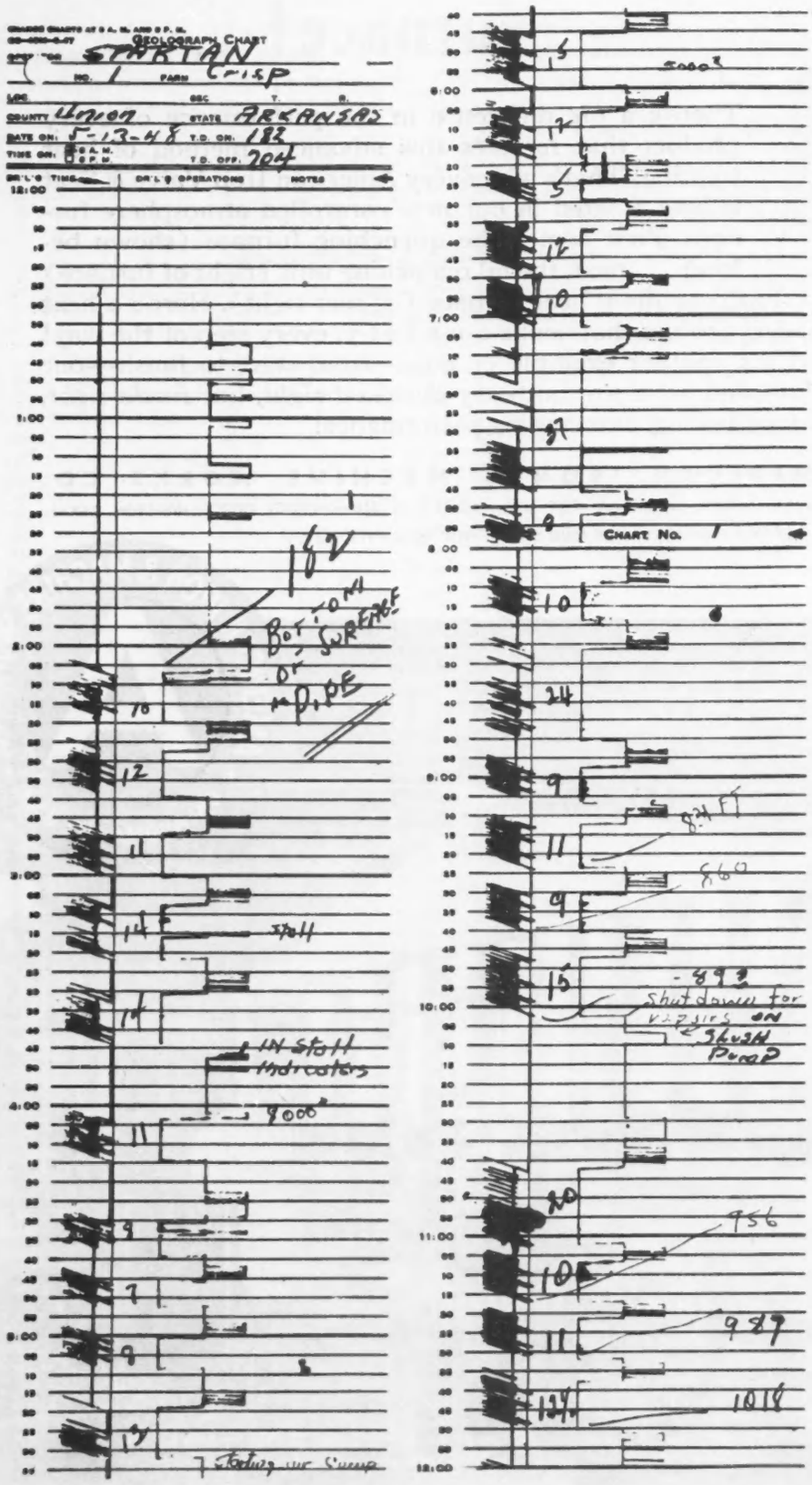
(below) Charging the controlled atmosphere furnace for the continuous heat-treating operation applied to every American Iron Valve & Seat.



run, would be made in five hours total elapsed time.

Typical drilling schedules with the 9¾-inch turbodrill are included with this paper, along with geolograph, caliper and photoclinometer logs for the first run, to give an indication of the proper operating setup and to illustrate operating results.

On the second turbine drilling operation, in the Bradley area of southern Arkansas, it was decided to use the turbodrill for the 20-inch surface hole, and a 20-inch rock bit was made up on the drive shaft of the tool. The section from the surface down to 300 feet consisted entirely of gravel and pebbles. It was found impossible to prevent large solids from washing into the tool through the bit when drill pipe connections were made, and the fluid courses became blocked. The need was obvious for a valve to prevent reverse fluid flow while making connections, or a screen to exclude solids large enough to block the fluid courses. Consequently, it was decided to return the tool to the shop for complete disassembly and inspection so that the exact nature of the gravel problem could be determined, and the working parts be examined for wear after the two field runs.



The shop inspection revealed no need for design changes in the tool itself to make it serviceable, long-lived and fully adaptable to use with conventional drilling equipment. The need was revealed for attachments on the tool to provide positive protection against large solids entering and blocking the fluid courses. These attachments have been developed and all turbodrills are equipped with these protective devices when delivered to operators.

The original turbodrill without modifications is being returned to its owner, the Spartan Drilling Company of Dallas, Texas, and will shortly be put into service on another commercial drilling operation.

Based on experience to date, the indicated advantages of the turbine method are as follows:

1. Faster hole. The availability of higher bottom-hole power means faster hole. Even with a larger bit than is customary with the rotary this advantage is pronounced. For example, at 10,000 feet with rotary using 4½-inch drill pipe, 8¾-inch bit and 125 rpm rotary table speed, and assuming that the hole is perfectly straight, the maximum power which can be applied to the bit is 40 hp, or 0.525 hp per square inch of hole area. With the 9¾-inch turbodrill, 6⅝-inch OD drill pipe, 12¼-inch bit, and 800 gpm of mud, maximum effective power on the formation is calculated to be 260 hp, or 1.73 hp per square inch of hole area. Bottom-hole power can be kept constant throughout, with fluid power losses in the hole compensated for by taking constantly increasing power from the pumps as the hole goes down. In this connection reference should be made to the table of drilling schedules.

2. Straighter hole. In turbine drilling, bit speed is higher, bit load is lighter, and the string neutral point is normally very close to the bit. For example, the neutral point, with five 30-foot, 8-inch OD drill collars in the string above the turbodrill, is approximately 30 feet above bottom with a bit load of 7500 pounds, 80 feet with 15,000 pounds, and 180 feet with 30,000 pounds. This combination of factors results in straighter hole and

A-6 100 hp

HR-4 110 hp

H-6 150 hp

HR-6 165 hp

HS-6 200 hp

NH-6 200 hp

HRS-6 225 hp

L-6 250 hp

NHS-6 275 hp

NHRS-6 300 hp

NVH-12 400 hp

NVHS-12 550 hp

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4. **NVH-12**—400 hp (max.), at 2100 rpm. 5⅛" bore, 6" stroke.
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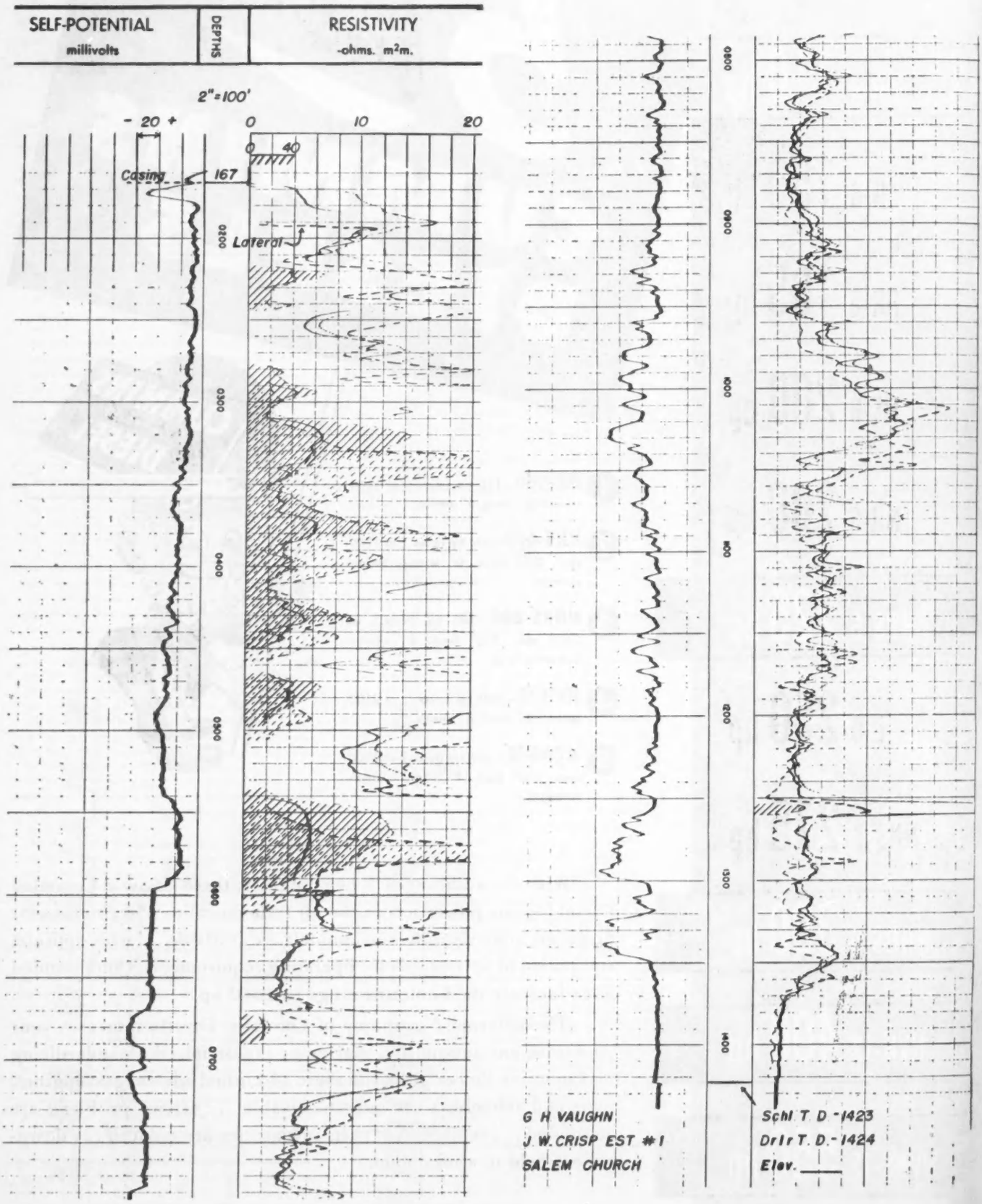
less tendency to drift in tilting beds.

3. Full-gauge, uniform diameter hole. The absence of drill pipe whipping in the hole, plus the straight-hole characteristic mentioned above, produces a true hole with fewer washouts, which is a recognized advantage in running and cementing casing.

4. Less wear on drill pipe. Wear on the outside of the drill pipe and tool joints is greatly reduced, since the pipe is rotated at only 10-15 rpm, and in many types of formation need not be turned at all.

5. Fewer fishing jobs. Most of the



First reading, 1423. Last reading, 167. Footage measured, 1256. Casing shoe log, 167. Maximum depth reached, 1423. Bottom driller, 1424. Depth datum, one foot above rotary. Mud nature, Quebracho-caustic soda. Mud density, 10. Mud viscosity, 51. Mud resistivity, 1.7 at 88° F. Maximum temperature, 90° F. Bit size, 13¾ inches. Spacings: AM, 16 inches; AM', 63 inches; OA, 24 feet. Rig time, 4½ hours.

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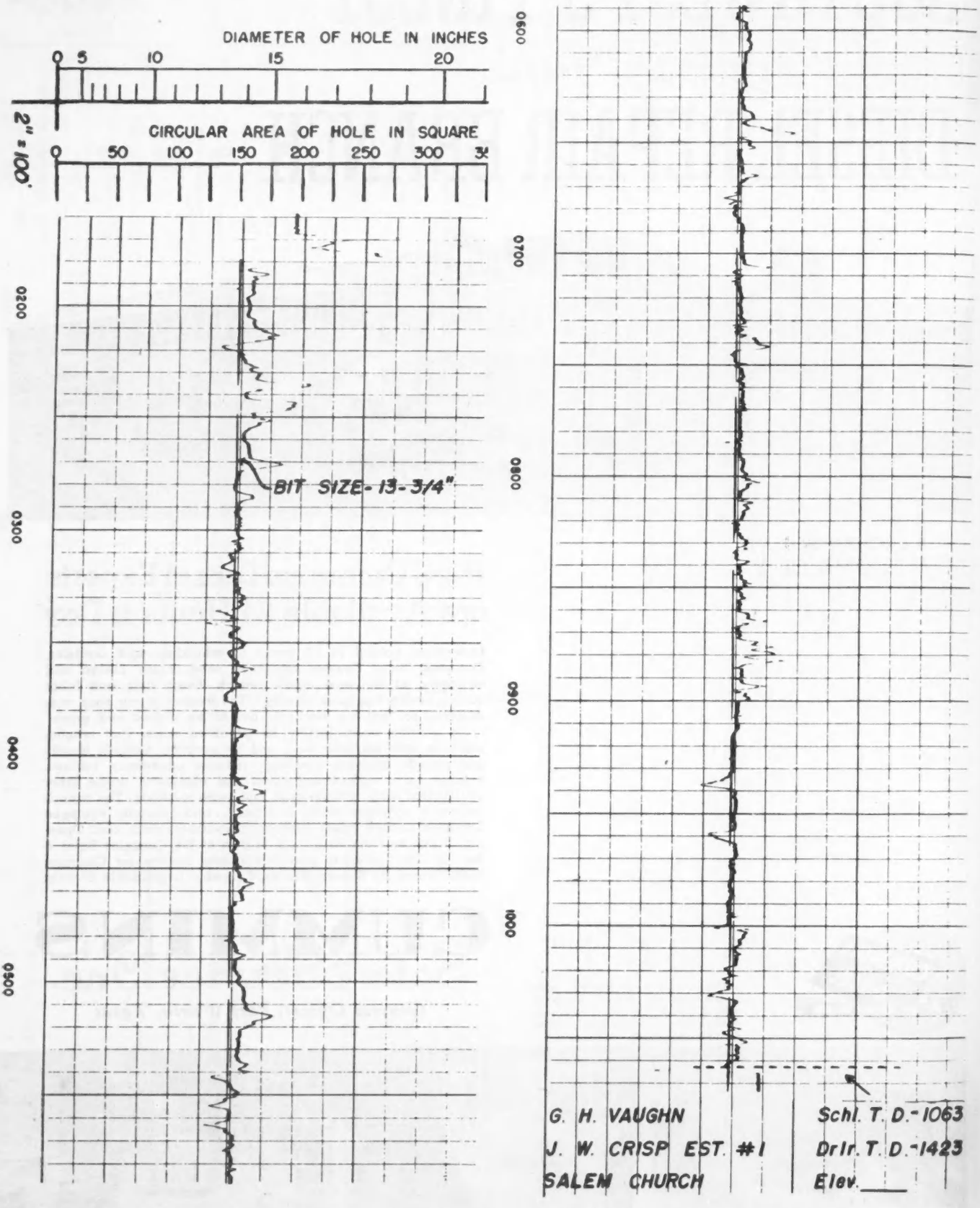
causes of drill pipe failure are eliminated in turbine drilling. The drilling shaft is not subjected to severe shock loads, flexing or other fatigue stresses which are always present in rotary drilling, and does not rub on the sides of the hole except at very low speeds. Twist-offs and backoffs are eliminated, and drill collars will not be left in the hole. Fishing jobs for cones and other bit parts should be much less frequent, because the turbine will stall when the bit hangs up before the yield point of the steel in the bit is reached. The danger of bit failure is always present in high-speed rotary drilling. Furthermore, key seating, another frequent cause of fishing jobs and lost holes, is certainly



First reading, 1063. Last reading, 167. Footage measured, 896. Maximum depth reached, 1063. Bottom driller, 1423. Depth datum, one foot above rotary. Bit size, 13¾ inches. Casing size, 16 inches outside diameter.

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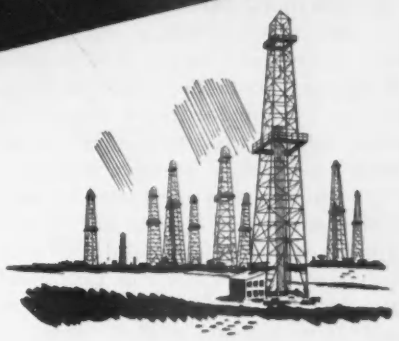
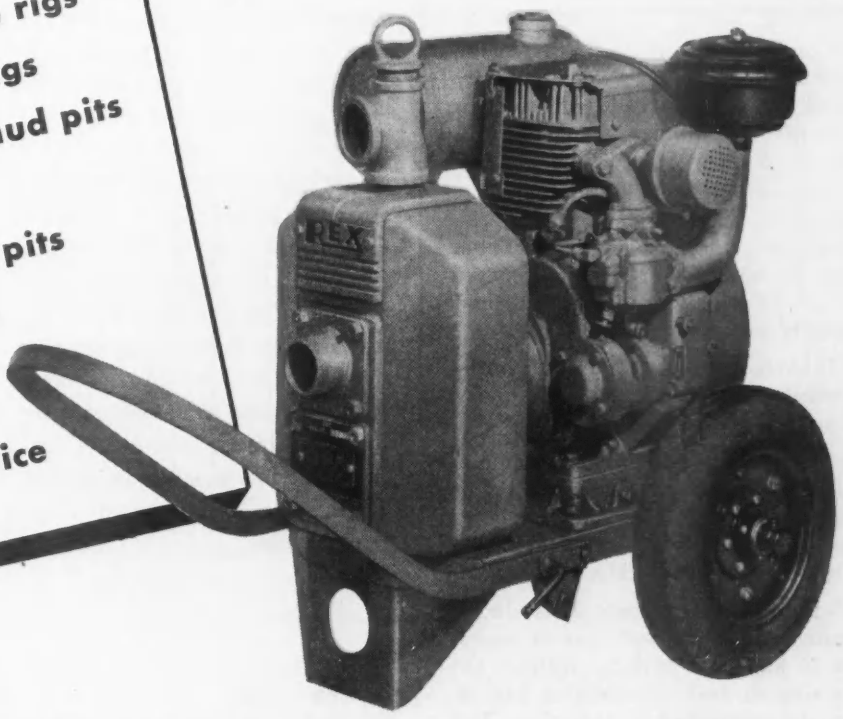


- Pumping water to the rigs
- Washing down the rigs
- Jetting water into mud pits
- Draining ditches
- Pumping out slush pits
- Transferring slush from pit to pit
- General dewatering service



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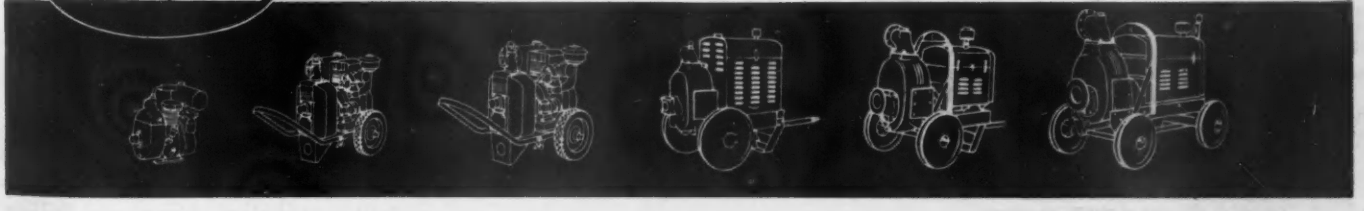


CHAIN BELT COMPANY of MILWAUKEE

much less likely in turbine drilling, because the hole is straighter and the pipe turns very slowly or not at all. In turbine drilling the most likely cause of a fishing job is caving, heaving or running of a formation, but with a straighter hole, drill pipe in tension throughout, and very low rotating speed of the pipe this danger should be greatly reduced. However, no matter how slight this danger may be, the bit used on the turbodrill must always be large enough to permit washing over the tool if the pipe becomes stuck. The absence of drill pipe whipping in the hole should also mean a reduction of the danger of casing collapse and the fishing jobs which can result. The turbine method does not create any new drilling hazards, and it eliminates or greatly reduces most of the existing ones.

6. Less wear on the rig. Wear on the swivel and rotary is very substantially reduced and there is little vibration on the derrick floor, which should mean a reduction in rig wear generally.

7. Cleaner hole. Liftability of the cuttings in the annulus is improved. The cuttings are smaller because of the higher bit speed, the character of the mud can be exactly the same, and fluid volume is as large or larger.

8. Interchangeability. Turbine drilling is fully interchangeable with rotary drilling.

9. Little special training required. Drillers do not need extensive training in turbine drilling. Experience shows that good rotary men learn to handle the turbodrill very quickly.

10. Possible fuel savings. It is clearly indicated that the coefficient of useful work is higher in turbine drilling, but no saving in fuel consumption can be definitely established at this time. The only true comparison between the two methods must be based on British thermal units required per foot of hole drilled through identical formations, and sufficient data for such a comparison are not available.

The indicated limitations of the turbine method are as follows:

1. Wire line core recovery is impossible with the tool in the string, and the lowest turbodrill speed, 175 rpm, is probably too high for conventional coring. The diamond core bit could possibly be used on the turbodrill, but fluid by-pass above the core head would be necessary because the minimum fluid volume for operation of the turbodrill far exceeds the maximum for the diamond bit.

2. If drilling conditions require the use of very heavy and viscous mud, the turbodrill cannot be used while the special condition exists.

3. In turbine drilling the bit speed range is 175-500 rpm and it is possible when using conventional hard rock bits that certain formations will be less drillable with the turbodrill than with rotary at bit speeds of 50-75 rpm. The final answer to this question can only be secured through extensive experience in hard rock drilling.

4. Wear on the slush pumps will be greater, since the pumps must do more work in turbine drilling. For this reason it is particularly desirable that the sand content of the mud be held as low as practicable. Good practice is to keep the amount of sand below 3 percent by volume, and as low as one percent if practicable. Since sand is detrimental to the mud cake, interferes with the running of casing and damages the pump, drill stem and bits, the use of desanding equipment will result in general operating economies, and will improve the turbine drilling operation.

In view of the ready interchangeability of turbine and rotary drilling, the limitations discussed under 1, 2 and 3 above do not appear to be very serious.

Drilling cost is a matter of supreme importance to the U. S. oil industry. U. S. average daily production per well is the lowest among all major oil producing countries, standing at 11 barrels against 5000 for the Middle East and 150 for South America. All drilling costs have greatly increased in recent years, and with the need for more and deeper wells the well cost problem is becoming constantly more acute. The old flush production days are a thing of the past. Production is costly to find, develop and maintain. Reserves and production can be sustained only by constantly intensified efforts in drilling, and these efforts must produce an economic return.

Any improvement in the oil well drilling technique which reduces well cost will eventually increase reserves and production by increasing ultimate recovery from existing fields, by making present sub-marginal production profitable to develop, and by rendering exploration for new fields less costly.

Turbine drilling, either as a general substitute for or complement to rotary drilling, gives promise of making an important contribution to improved drilling efficiency and economy.

About the Author

CRITCHELL PARSONS was born in Glencoe, Ill., worked in oil fields and as a civil engineer in New Mexico and won a degree in economics and geology and a Rhodes scholarship at the University of New Mexico. He took a degree in economics from Oxford University in 1935, studied in the field of international petroleum trade for a year at the Oxford Institute of Statistics, and then was associated with Socony-Vacuum Oil Company in the Middle East from 1936 through 1940 and with Socony in New York in 1941. He was assistant chief of the Petroleum division, Foreign Economic Administration in Washington for four years. Since 1946 he has been president and general manager of Engineering Development Company, Dallas.

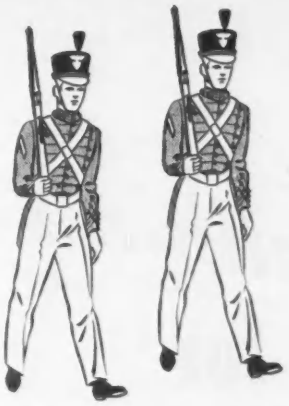
Typical Drilling Schedules with 9¾-Inch OD 90-Stage Turbodrill

DEPTH, FEET	Drill Pipe Grade and ID Inches	Steam Slush Pumps*	Fluid Volume gpm	Floor Gauge Pressure psi	Power Offtake from Pumps HHP	Effective Power on Bit HP
Surface	.....	1—18x7¾x20	600	800	280	135
2500	C 4.859	1—18x7¾x20	600	1000	350	135
10000	D 4.859	2—18x6¼x20	600	1650	575	135
5000	C 5.965	1—18x7¾x20	600	975	340	135
10000	D 5.965	2—18x6¾x20	600	1150	400	135
12500	E 5.965	2—18x6¾x20	600	1250	435	135
15000	E 5.965	2—18x6¾x20	600	1325	460	135
Surface	.....	2—18x6¾x20	800	1000	465	260
7500	C 5.965	2—18x6¾x20	800	1425	665	260
10000	D 5.965	2—18x6¼x20	800	1575	735	260
12500	E 5.965	2—18x6¼x20	750	1535	675	230
15000	E 5.965	2—18c6¼x20	750	1650	725	230

Note:
1. Minimum bit size: 12¼ inches.
2. Calculated stall loads on bit: 26,000 pounds at 600 gpm.; 44,000 pounds at 750 gpm.; 50,000 pounds at 800 gpm.
3. Bit speed range: 175-500 rpm.
4. Mud weight range: 8.35-13.0 pounds per gallon.
5. Boiler steam: 325 psi.
6. Pumps in parallel where two required.
7. Volumetric efficiency of pumps: 80 percent.

* Or power pumps of equivalent capacity.

It's smart . . .



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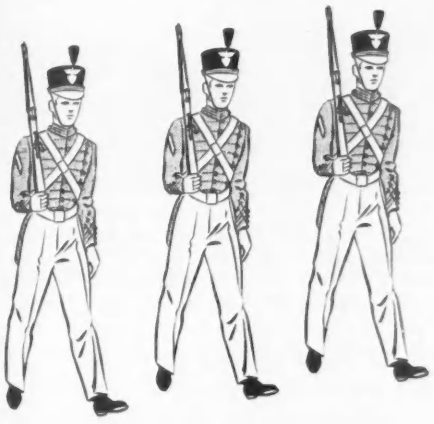
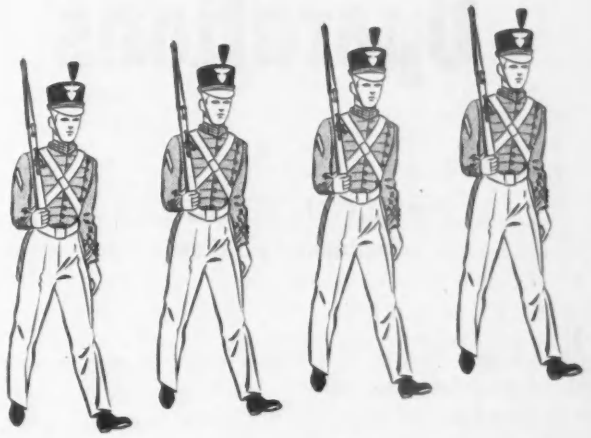


It's smart to drill with . . .



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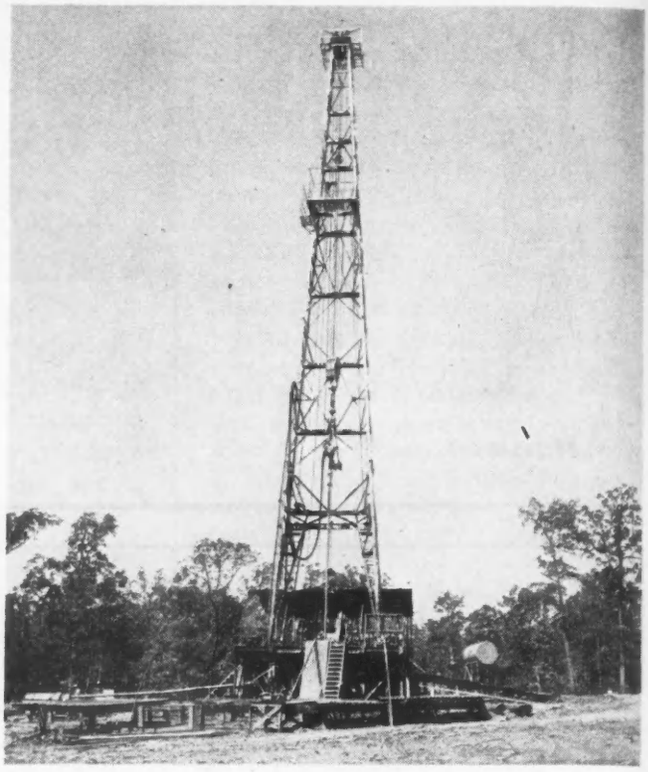
Streamlining for Jackknife Operations

By ELTON STERRETT
Engineering Editor



The Earl Callaway rig set up for drilling on side-hill location, with unitized mud and shale shaker systems connected for a right-hand setup. The rig handles standard 4½-inch drill pipe in thribbles, with 1¼-inch line.

DRILLING in the Waskom area of East Texas, where gas distillate production is found at depths below 6500 feet, a 128-foot jackknife rig operated by the Earl Callaway Drilling Company has already bettered former records to the productive zone over derrick-type rigs and has greatly reduced time between locations through ingenious methods worked out for shifting the mast intact where no major highways or bridge structures impose width or height restrictions on the load.

Much of the time saved in moving is due to careful streamlining and unitizing of equipment, each piece of which is designed for serving effectively in two or more roles while on the move or on location.

Slush pump setup, for example, is reduced to a minimum and all pipe connections are standardized through the application of a special platform skid which is placed between the main pump and the standby unit and there serves as spacer to maintain the two units so that the connection distances between spherical unions is always the same. Since the main pump is aligned with the base of the derrick sub-structure, so as to allow proper adjustment of the V-belt drive between derrick floor power source and the main sheave, use of this spacer insures that all mud lines remain in alignment also. The spacer skid, floored throughout with heavy plate to form a smooth surface, serves as walkway for servicing the pumps and for setting up or taking down the connections between mud pump discharges and the manifold.

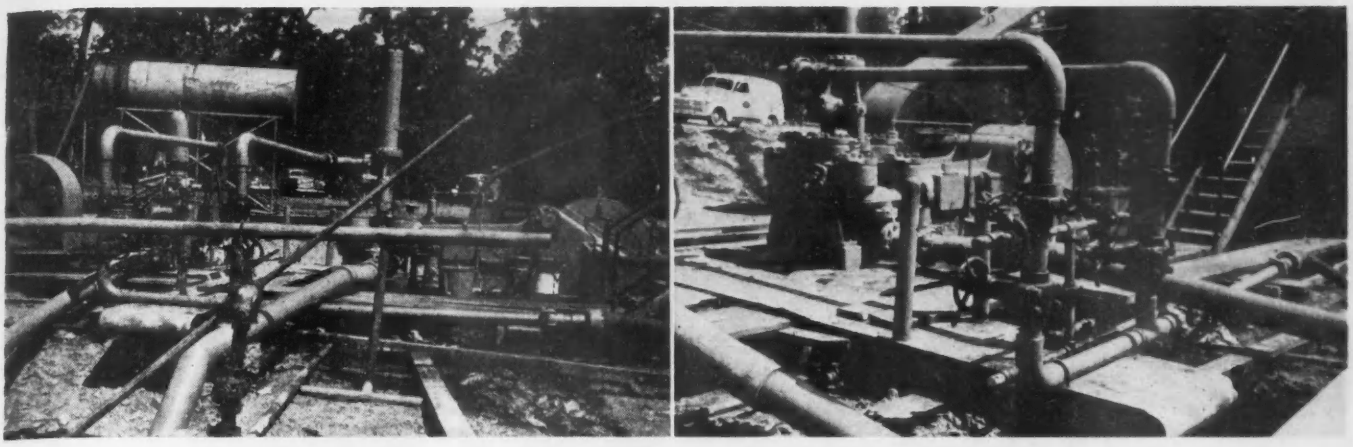
To accommodate the fixed sections of mud discharge lines between the spherical unions, it is necessary only to shift the skid laterally between the two pump foundations until the desired center distances are obtained. Any variations between the levels which support the connection platform and either of the mud pumps is absorbed by the spherical connectors and it is not necessary to provide through supports in an effort to maintain the entire mud pumping setup on one plane. This feature is especially desirable when the location is in swampy ground, where settlement gradually takes place as vibration tends to compact the spongy support beneath the units; as well as on side-hill locations where heavy rains may cause washing and thus change the conformation of the shelf originally excavated to support the equipment.

Four 4-inch pipe posts, bull-plug ended on top for smoothness and safety, are welded to the skid plate, and serve as supports when on the move, all mud piping being dismantled at the unions and laid on this skid in the order in which they are taken down.

The horizontal run of the tie-in manifold is clamped to the end of the spacer skid by two U-bolt fastenings, and remains in place at all times. The two control valves are also left in place on the upright members of the manifold, being protected by the overhang of the skid from damage while on the move. The hand wheels, which might sustain injury, are removed, leaving only the bare stem or spindle.

Location of the sweep ell and the tee into which the mud discharge lines are connected outside the area spanned by the support posts on the skid, these lines are relieved of any possible side thrust when material is being transported between locations. If desired, loosening of the U-clamps will permit the tie-in section to be rotated through 90 degrees and laid flat alongside the

SPECIAL ATTENTION to details and designing equipment for dual use enable one contractor to speed up drilling operations and also to make the move between locations in a minimum of time. Flexibility, built into all mud lines, for example, prolongs valve life and simplifies setting up. Design features permit right- or left-hand hookup of system, according to location of pits to utilize terrain features.



LEFT: General arrangement of mud system, with main pump abutting substructure and second pump across the unique spacing skid which carries piping and provides working platform.

RIGHT: Method of attaching tie-in section of mud discharge line to special skid, showing location of block gates and spherical unions, with storage rack posts appearing to the left of the mud lines.

I-beam members which form the sides of the skid. When rigging up, the U-bolts are not pulled down tight until after the mud lines have been connected, allowing the alignment to adjust itself without imposing tensile or compressive loads on the connections.

From the manifold, the mud line extends through one length of pipe toward the derrick, where a short length of standard rotary hose is inserted, to absorb vibration and differences in alignment or elevation between pump skid and derrick substructure. This short length of mud line is connected to the manifold through a spherical-type union. The rubber hose is made up with ample slack between the two pipe ends so as to allow the hose to shorten as necessary when filled and under mud-line pressures. If sufficient slack is not incorporated in this setup, the hose will pull loose from one end or rupture under the lateral or axial stresses imposed on it.

Power Plant Skid

The usual power plant skid, mounting generating plant for rig lights, compressor, and centrifugal or positive-type water pump, is equipped with a generator to provide current for any welding which may be required around the rig. Added to the usual equipment is a separate 110-volt lighting unit, direct connected to an individual drive gasoline engine. This auxiliary lighting unit is tied into the usual rig lighting circuits, and can be used to handle the illumination load if the larger unit is down for any reason. The air storage tank is mounted at the back of the skid, out of the way when servicing any of the units, and set up so as to permit drainage of any water entrained during compression.

The fuel line for the power plan skid is equipped with a valve at each end of the hose. The use of the valve at the end of the hose permits close control of fuel into the tanks on the skid, while the valve in the end of the pipe beyond the point of hose attachment permits pressure to be cut off at that point, and the hose relieved of fuel pressure or drained between the relatively infrequent times of use.

Flexibility of all piping connections, so as to absorb shifts in relative positions of units due to settlement, vibration or other causes, is even carried to the mud discharge line from the casing to the mud screen. Two sleeve-type couplings are used to break the line into three relatively independent sections, and thus protect the valve on the mud line and the tie-in to the shaker unit. Use of the couplings allows for considerable variation in center-line distances between rig and shaker without requiring welding or pipe cutting to establish the line.

Superimposed mounting of sand line over main drawworks drum centers control for the driller and economizes on floor space, at the same time reducing the number of units to be handled between locations.

The drawworks, rated for 500-horsepower input, is driven by two dual diesel units, and carries 1¼-inch line on the main drum and the standard sand line on a second drum, superimposed over the first and controlled from the driller's position.

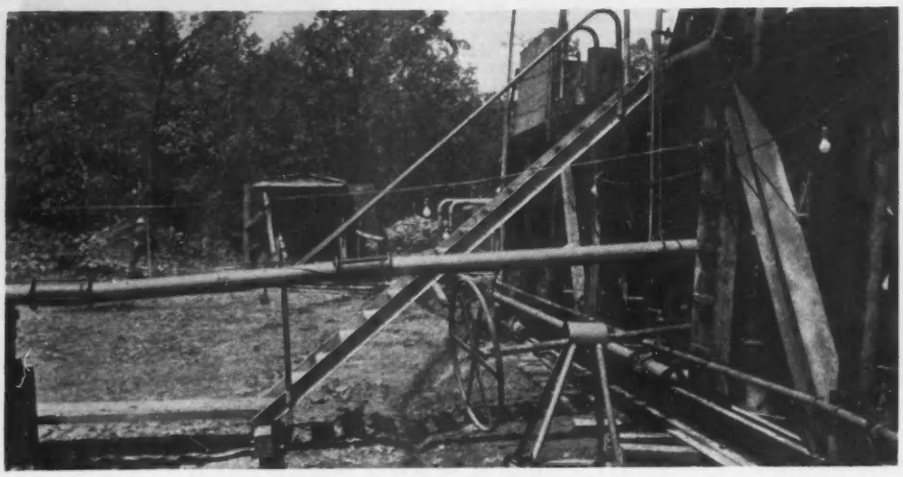
Drill pipe is handled in thribbles, and stacked outside the frame of the mast. Standard 4½-inch drill pipe, stored on a rack in extension with the open side of the derrick, is handled with the catline and fed to the drilling string through a mouse-hole directly in front of the rotary table. Discarded drill pipe, cut into proper lengths and welded ten abreast to form a skid, serves to join pipe walkway and derrick floor. The skid pipe ends are closed with steel plates set at an angle of approximately 45 degrees to the run of the pipe. The plates are each set up with one-half-inch holes drilled across the toe section, but normally only the edge overlapping the derrick floor is nailed down, allowing the end on the walkway to adjust itself to slight variations in level without tending to work the fastenings loose or to pull them out if the shift becomes sufficiently pronounced.

Meeting Terrain Demands

The rig is so designed and fabricated that the only continuous level area required is the surface actually covered by the derrick sub-structure. Smaller level areas are then set up on most convenient heights to accommodate the mud pumps, fuel tank and other auxiliary skids.

The mud pumps, mud line to standpipe and other units set at ground level outside the derrick proper are arranged so that the tie-in may be either right- or left-handed, as terrain conditions may dictate.

The setup illustrated has the mud pits located at the right of the rig, or



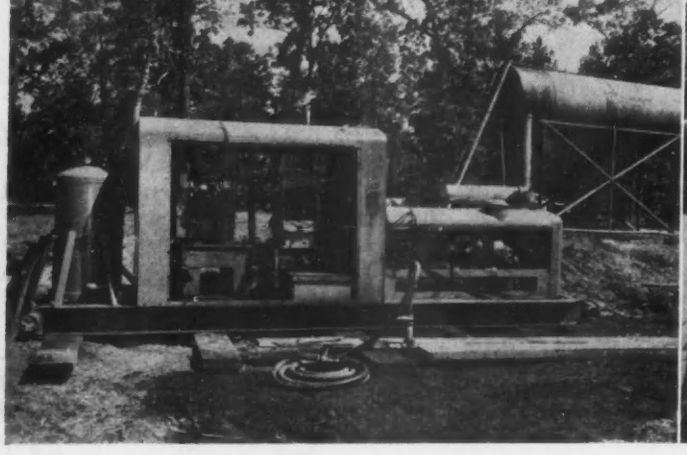
Flexibility is introduced into the mud flow line by use of sleeve-type couplings, which eliminate close measuring for setup, and also absorb variations in levels between substructure and shaker.

The tie-in unit between pipe ramp and derrick floor is made up from sections of discarded drill pipe, provided with heavy toe plates to distribute load and provide tie to derrick floor and ramp.

on the driller's side, but the pits may be placed on the opposite side of the mud pumps simply by reversing the setting of the suction nipples in the two pumps. Delivery of pressured mud is always as shown, with the mudline passing along the base of the sub-structure to the standpipe at the side of the derrick framework. Manual operation of the blowout preventers is dependent on the facing of the mud return line, and is aligned with that line as being on the side of the sub-structure having the greater vertical clearance.

Change rooms, dog house for the mud engineer or geologist, and lockers for storage of spare parts are built into the sub-structure of the unit, along each of the rectangular slides which form the two side members of the derrick support. These rigid members are tied together with adjustable spacers which maintain the rigid sections in proper alignment under any shifting which might take place with slight settlement of the terrain. Both transverse and crossed diagonal braces, provided with turnbuckles or adjustable ends, are used for this purpose, the end frame toward the main mud pump being fabricated as a truss to take the thrust set up by adjusting the centerline of main sheave with that of the drive on the derrick floor above. The V-belt drive for the pump is housed over with top and bottom plate shields, and with open mesh sides for ventilation and visual inspection of the belts. When properly adjusted and aligned, a set of belts may be counted on for a year or more of satisfactory service. Replacements are made by set only, using matched belts.

The derrick has been transported between field locations without dismantling. Crown block is sent down, and then the derrick laid flat, the base being cradled in a special, fifth-wheel type of support on a special truck bed, and the upper end carried on a yoke superposed on the side-boom structure of a crawler-type tractor. This support also provides full pivoting action, so that the truck may be driven over a winding lease road, or around a full 90-degree corner, and the mast carried in position to avoid trees, fences, and other obstacles by expert handling of the tractor carrying the tip of the unit. Where conditions permit, the tractor can make a wide sweep to either side so as to keep the load in alignment. At the new location, the base is winched from the truck and the tip carried on the tractor until it reaches a point directly in line with the arc through which it must be lifted as the derrick is erected.



LEFT: The unitized auxiliary skid, showing second and individually driven lighting unit mounted above the main drive unit. This provides current in case the main engine or generator is down, and insures light at all times.

RIGHT: Day tour on the rig, with, left to right, F. A. Coyle, toolpusher; Chuck Hardcastle, derrickman; M. E. Evans, driller; Bill Mazingo, helper; Matt DeMoss, helper.

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Wire Lines For Cable Tool Drilling

By R. B. ANDERSON
Columbian Carbon Company

THE USE of tailor-made tapered drilling lines for penetrating below depths where the factor of safety is unduly diminished and proper precautions as to sheave diameter and reverse bends is discussed by its author. These factors are shown to permit safe operation at depths hitherto considered below cable tool limits. The paper, presented before the Spring meeting, API Division of Production, is here substantially in full.

CABLE tools are used almost exclusively in the Appalachian area for drilling oil and gas wells. As the name implies, the cable is a very important element and in many respects is the limiting factor in the application of this method. Selection of the proper cable or wire line for the job is therefore of first importance.

Different types of drilling equipment impose somewhat different wire line requirements. For example, more severe conditions are experienced on the spudder than on the drilling machine or standard rig from the standpoint of the sheaves and drums. All wire rope manufacturers will doubtless agree that a reverse bend over sheaves requires larger sheaves than a bend in just one direction. The drilling machine and standard rig do not work the line over sheaves or drums while drilling, but only while pulling out or running in, if we except the first few hundred feet that are spudded. The spudders usually operate over three sheaves and one drum at all times and two of the bends are reverse bends. It is obvious, therefore, that the line construction on a spudder can be very important and the construction should be such that can best withstand bending stresses.

Some manufacturers recognize that the minimum drum and sheave diameter varies with the construction for a given size of line and equal number of wires—other manufacturers do not. The Eastern District •API Subcommittee on Wire Rope has requested the American Petroleum Institute to establish critical and minimum sheave and drum diameters for each construction commonly used in the oil fields. This problem is before the Manufacturers' Subcommittee and a recommendation may be made by them at the next annual meeting. It is much needed information.

There are at least two manufacturers that publish minimum diameters for various constructions as shown in Table 1.

The manufacturers are not in agreement, but it is obvious that there is a material difference in flexibility between various constructions of the same size wire line with the same number of wires.

Few standard rigs have bull wheel drums as large as 18 inches (the minimum for ¾-inch line)—none with 21 or 30-inch bull wheel drums. Some spudders have bull wheel drums as small as 13⅛ inches with sheaves, where reverse bends are made, as small as 25 inches. From the standpoint of bending stresses it would appear then that the most flexible construction is the most desirable on all drilling equipment, and certainly quite important on spudders. This would be the 6 x 25 Filler wire construction, formerly designated 6 x 19 Filler wire construction.

Flexibility is not necessarily the only consideration. Resistance to wire breakage on the bull wheel, resistance to abrasion in the hole are additional elements that must be considered and given their proper weight. The final decision must be a compromise. Larger outside wires on a line no doubt best resist individual wire breakage on the bull wheel drum. That is doubtless the reason the Seale construction is popular on rotary drilling outfits. On cable tools, spooling can be controlled and it must be remembered that one broken large wire on a Seale construction line is much more serious than one broken wire on a Filler wire construction line because a high percentage of the total strength of the Seale construction is in the large outer wires. As to abrasion, all constructions of wire lines commonly used for drilling have the same amount of steel per hundred feet of line for each size. It seems logical to assume that abrasion from the hole will remove just as many pounds of steel from a given hundred feet of line of one construction as it will from another. The size of the outer wires would have little if anything to do with solving that problem so long as equal grades of steel are compared. Reasoning along these lines leads to the conclusion that coarse outer wires will not retard or reduce the rate or amount of abrasion. The remaining strength in any worn line is largely determined by the remaining steel in that line.

Selection of the construction of a line must be made from the standpoint of ability to absorb bending, resistance to wire breakage on the bull wheels, and resistance to abrasion in the hole. The operator must evaluate the importance of these elements on his job and select that construction which in his judgment best serves his particular job.

TABLE 1

	Minimum Sheave and Drum Diameter		
	Mfr. A. Inches	Mfr. B Inches	A.P.I. Specifications Inches
¾-inch—6x19 Seale	25½	22½	22½
¾-inch—6x21 Filler (6x16)	22½	19½	....
¾-inch—6x19 Warrington	22½	18	22½
¾-inch—6x25 Filler Wire	19½	18	22½
⅞-inch—6x19 Seale	29¾	26	26
⅞-inch—6x21 Filler (6x16)	26¼	22¾	26
⅞-inch—6x19 Warrington	26¼	21	26
⅞-inch—6x25 Filler Wire	22¾	21	26

Safety Factors

The proper safety factor for any job is determined by experience and judgment. In drilling we can calculate the weight of the tools and line but the inertia loads, stresses from tools sticking and the innumerable unexpected condi-

tions that occur are hard to evaluate.

As a general proposition a larger factor of safety is required at shallow depths of 1000 to 2000 feet than is necessary at greater depths. The reason for the higher safety factor requirement at shallow depths is if tools stick on the down stroke there is very little elasticity in the short length of line and greater strength is required to prevent breakage on the up stroke. Just what the proper safety factor is depends to a great degree on the care of the driller. If care is used to set the drilling clamps or brake on a spudder just tight enough to hold the tools the line will feed if the tools stick and a factor of safety of 7 or 8 would probably be sufficient. If such care is not taken the highest factor of safety obtainable is none too high.

Experience seems to indicate that a factor of safety of six is about the minimum for greater depths if wire line trouble is to be avoided, and where possible a factor of seven is a better figure to work to. Sand lines are used on less severe service than drilling lines and a factor of five to six may be sufficient.

Tapered Drilling Lines

Drilling depths in excess of 6000 feet have been handicapped in the past by excessive wire line failure. Wire line cost is one of the largest items of expense in drilling deep holes. Improved plow steel lines have helped but have not fully solved the problem. Upon reference to Figure 1 the reason is evident. It will be noted that with tools weighing 3000 pounds, a factor of safety of 7 is reached for a ¾-inch line at 4280 feet, for ⅞-inch at 5000 feet, for 1-inch at 5700 feet, for 1⅛-inch at 6000 feet. The safety factor is calculated from the dead load weight of the line and tools at varying depths and does not take into account inertia loads, etc. We know we do not have too much wire line trouble above 6000 feet so we can infer that so long as we operate our lines with a safety factor somewhere between 6 and 7 we can expect to have little trouble. The chart brings out clearly that after 6000 feet is passed, it makes little difference what diameter line we use—trouble and costs will accelerate. Faced with this situation, the solution is to eliminate all unnecessary weight.

Tapered lines are not new. The first ones were made many years ago by splicing a smaller diameter line to a larger diameter line. They were not satisfactory. Later, tapering was accomplished at the mill by brazing or welding smaller wires to larger wires when the line was fabricated. Early tapering was done over lengths of 50 to 150 feet. The taper was quite evident and rapidly wore at these points. Tapered lines made in this manner were little better than the spliced tapers.

Today, the lines are tapered over almost their full length. Referring to Figure 1 line designated (A) is fabricated with 2900 feet of uniform ⅝-inch line. At that point the taper starts and gradually increases in diameter, at a uniform rate, until at the end of 11,400 feet it has reached a diameter of 1⅛-inch. Line designated (B) is fabricated with 5500 feet of uniform ¾-inch line. At that point tapering starts and is continued at a uniform rate until it reaches a diameter of 1⅛ inches at 13,000 feet. These two designs will permit a driller to use 3000 pounds of drilling tools with line (A) to a maximum depth of 11,400 feet and never work his line below a factor of safety of 7. Design (B) can be used with 3000 pounds of drilling tools to a depth of 13,000 feet and not drop below a factor of safety of 6. Tapers of these lengths wear evenly throughout and have been, and are now, giving the kind of performance that formerly could only be obtained at shallow depths. They have solved one of the serious cable tool deep well drilling problems. These lines are tailor-made, engineered and designed for the particular job required by the operator.

Two examples will illustrate the value of uniformly tapered drilling lines. One drilling line that started with ⅝-inch line at the bottom and tapered to ⅞-inch at 8000 feet was put on at a depth of 5800 feet and finished the well at 7400 feet. The line worked 104 days in 5000 feet of uncased hole. Another line was a 10,000-foot gradually tapered drilling line. It was put on at a depth of 8150 feet and taken off at 9900 feet because it was too short. It had been used 80 days in as much as 2800 feet of uncased hole. Such wire line performance at these depths is unprecedented.

In addition to the durability of tapered lines, other dividends accrue with their use: horsepower savings are material, spooling capacity is increased, machines designed for depths of 3500 feet can be, and have been used to drill to 7000 and 8000 feet without materially overloading them.

Smaller diameter portions of worn out tapered lines make excellent sand lines for big bailers when starting new holes. The upper ends of the tapered lines are usually not worn badly when the line becomes too short for deep work. These portions are of ample size and length to start new holes.

A spudder recommended for 3500-foot drilling and equipped with a 113 hp engine drilled, without any modification whatever, a six-inch hole to 8032 feet with conventional drilling tools. The weight of the ⅝ to ⅞-inch tapered drilling line was little more than 4000 feet of ⅞-inch line and conventional eight-inch tools. This illustrates what tapered drilling lines mean to the cable tool driller.

The Eastern District Subcommittee on Wire Rope has recommended to the API Committee on the Standardization of Wire Rope that a specification be adopted for tapered drilling and sand lines. The National Committee adopted such a specification, with modifications, and tapered lines can now be purchased under regular API Specifications. When ordering under API Specifications it is important for the purchaser to specify the length of the taper desired. If this is not done it may be made as short as 75 feet on a ¾-inch line, and that length may not be sufficient for best results.

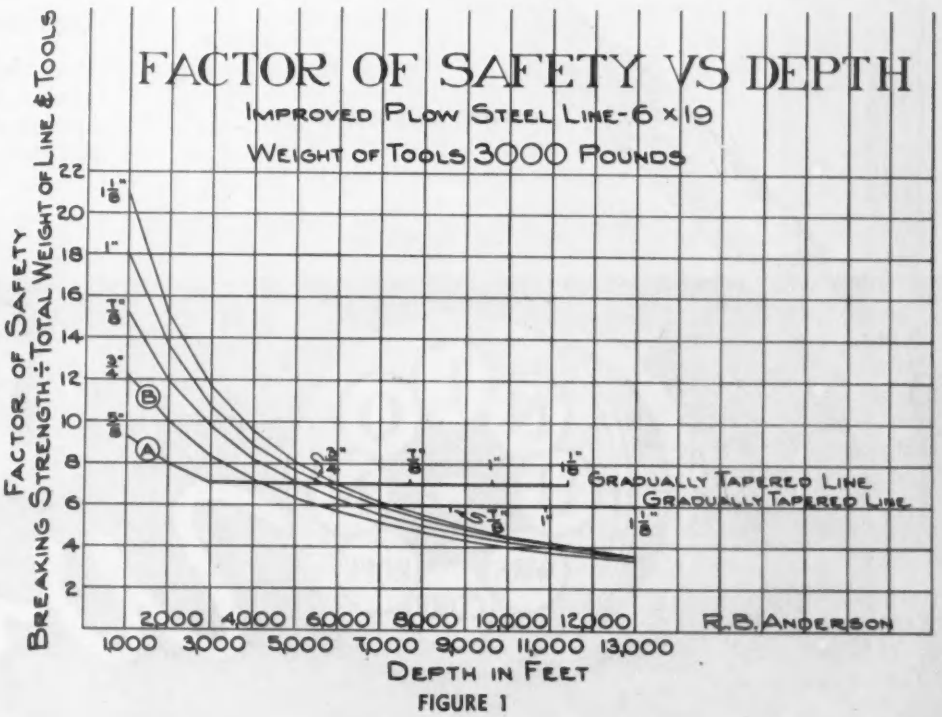

FIGURE 1

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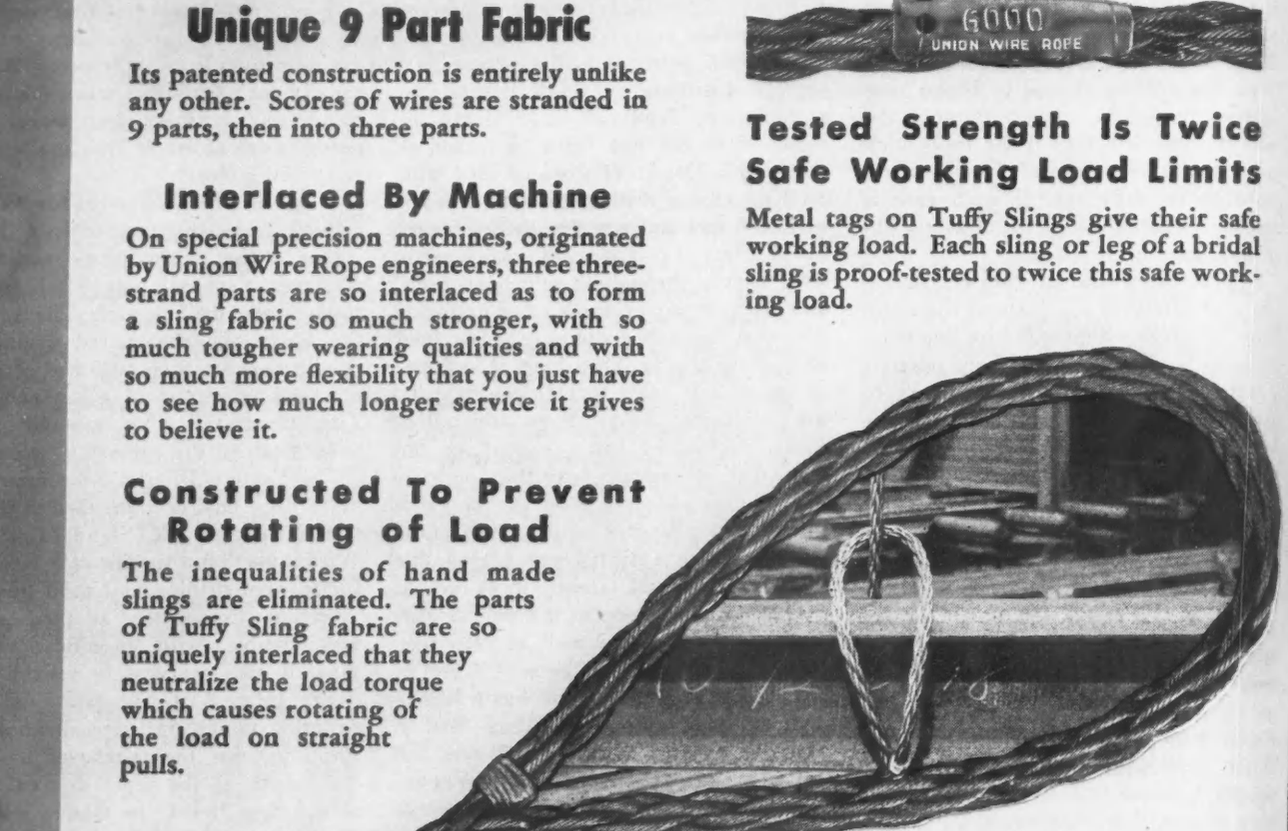

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Breaking in a New Employe

By C. W. YANCEY
Safety Director, Rowan Drilling Company, Inc.

THE period of breaking in a new employe has always been a period of lowered efficiency and of increased hazard to a drilling crew. Rowan Drilling Company, Inc., now has in effect a trainee program through which we break in practically all of our men who are new to the drilling industry.

This program was primarily designed to get more men back into the drilling industry, to combat the depletion of manpower suffered during the war years, and to train men in their duties and safe working practices before putting them to work in a regular crew. The program is open to any young man desiring to go to work in the drilling industry and who has had no previous experience on a rig. Effort has been made to get men with some specialized training.

To get these men, we have gone or written to various schools, both technical and educational, and stated that we had work to offer men in the oil drilling industry. When an applicant comes to us wanting to go to work under this setup, he goes through a screening process. Here are some of the things he is told about:

1. The rate of pay on training period and regular rate of pay after training period.
2. The type of men with whom he will be working are sincere, hard working, though sometimes rough talking.
3. The safety program and type clothing, shoes, hats and gloves we recommend.
4. The rigs run 24 hours a day and that his training will be on day tour; but at the end of that time he may be placed on any tour and it may be at any helper's job, according to the opening at that time.
5. He is directly responsible to the driller and takes his orders from him.
6. The way he progresses depends on his individual adaptability to the job, and how he applies himself.
7. The job is outside work and hard work, and he is likely to get muddy and greasy at any time he is on the job.
8. Living costs are very high for accommodations required.
9. He is subject to be moved at any time.
10. How the transportation problem is handled by the crews (alternate driving or pay transportation).
11. The training period is considered a trial period from his angle as well as ours.
12. Employe benefits offered by the company and how he can take part in them.

Then if the applicant still thinks he would like the work, considering the conditions, he is sent to a doctor for a physical examination. If he is passed by the doctor, he is then sent to one of our division offices for placement. The division heads then talk to him and try to place him on a rig on which his particular training or background would help him most. He is then sent to the superintendent in charge of the rig selected who places him on day tour to work for the driller on that tour. The day tour driller conducts this training. Usually our most efficient and safest workers are on day tour and are considered most capable of training the new man in safe work procedures. Too, they will not be hampered by darkness in showing him how various pieces of equipment work.

Training Schedule

His period of training is 28 days as the sixth man in a crew, and it goes something like this:

The first day or two, the trainee doesn't do much actual labor. He is introduced to the other men on the crew and also informed as to their job titles. He is taken about the rig by the driller or one of the other crew members and told the names of various pieces of equipment and their functions in drilling a well. He is particularly warned of danger points in the servicing and operation of various parts of the equipment. He is shown the location of first aid, fire extinguishers, etc.

After the introductory period, he is assigned to help one of the floormen with his regular duties. Particular care is taken by the driller and other crew members that the trainee learns the correct and safe way of doing any job he does. He is then assigned to help the other floorman with his job and learn the working methods usually practiced by him. The derrickman then takes his turn for three days of teaching the trainee in the duties of the derrickman and safety precautions to take while working on pumps, jetting, etc. If the trainee so desires he may go up in the derrick and watch the derrickman while making a trip. Extra safety belts are available for him to use while watching. If he wants to try working derricks, he is allowed to do so with particular precautions being taken by the driller and derrickman not to let him get hurt. Then the motorman is given his chance as instructor. The trainee is assigned to help him for about five days. This includes servicing the engines and what to look for on his rounds of inspection. The motorman also will teach the trainee the relation of his work to the other crew members' work and how to help them and the driller. Of course, the time spent on each phase of the training may vary with the characteristics of the man and how quickly he catches on and adapts himself to the work.

The trainee is now ready for trial periods of work, replacing any member of the crew as the driller elects and at a time the driller can keep a watchful eye on him. The driller and superintendent watch for his adaptability to certain jobs

This paper was initially presented before the Fourth Annual Safety Drilling Clinic of the American Association of Oilwell Drilling Contractors at Dallas.

and these opinions are passed on to the division heads. By the time the training period is over, the average trainee has a working knowledge of general duties of the crew members.

During the period of training the trainee is encouraged to ask any questions that pertain to the work or equipment and the answers are given without ridicule. If he decides he does not like the work or cannot make a roughneck, he is free to quit at any time. If he becomes dissatisfied with the treatment he receives, he is free to go to the driller or superintendent with his troubles. If the driller or superintendent can see the trainee has a just cause to be dissatisfied, he can arrange for the trainee to be transferred or take action on the crew as the occasion demands. On the other hand, if the driller and superintendent do not think the trainee has the proper attitude or is not progressing suitably, after a few days trial, they will talk to the trainee and explain to him what his trouble is and reach an agreement with him. If the trainee thinks he can better his progress, he is given another trial. If, in another week or so, the trainee doesn't show better progress, the driller will lay him off, giving him an explanation of his action.

When the trainee completes the training period, he is placed in a regular crew wherever an opening presents itself. Special attention is paid to the trainee's adaptability to the different jobs and an effort is made to place him in a job he likes and is adapted to. If there is not an opening on any of our crews for that particular job, he is used wherever the opening is until the right job is open. Then he is transferred to the job of his suitability. His advancement to other jobs depends on his ability and application to the job. Even if the trainee has had technical mechanical training and is aiming at a motorman's job, we think he should be a good experienced floorman before taking over the duties of a motorman.

In conducting this kind of program we lessen the chances of impairing the safety and efficiency of the crew of which he becomes a regular member. As an extra man on the training crew, he will be able to do enough work to offset time lost shutting down for explanations or showing him how to do something.

The results of this program have been good. Of all the men who have gone to work for us through this program, only one has suffered a lost time accident while in training. The turnover on these men has been considerably less in percentage than our over-all turnover.

The main thing we find that causes these men to quit is the fact that the work is not as they had pictured it to be even after being told how the work goes.

Suggested Standards for *Wire Rope Cutting*

CUTTING of wire rope to eliminate drum-crushed and severely stressed sections of the drilling line is an item of rig practice which varies widely with tool pushers, drilling superintendents, and drillers. No fixed standard has as yet been universally established, as with other phases of rig maintenance, and in consequence much rope is wasted in the desire to be on the safe side. A few feet of wire rope, prematurely cut off and discarded, is regarded as inexpensive insurance against possible lost hole or equipment damage.

The article "Increasing Life of Rotary Drilling Lines," by L. C. Torell, which appeared in WORLD OIL for May, 1949, mentioned recommended cutting practices for both IWRC and fiber core lines, which had been developed in accord with much experimental data. Through the courtesy of the Bethlehem Steel Company these recommended practices are shown in the accompanying tables.

Taking figures shown for the 4½-inch drill pipe diameters as example and comparing average ton miles between drum cuts, the IWRC average is approximately 50 percent greater than that obtained for fiber core line if the entire depth drilled be used, or nearly 75 percent if depths below 6000 feet only are compared. The amount removed per cut also shows a wide variation, being 70 to 80 feet for the IWRC and 40 feet for the fiber core line. The 850 feet of line available for making drum cuts is used in making ten to 12 cuts in the IWRC or approximately 20 in the fiber core line. The time required for making the pull-through and cut is approximately the same, whether 40 or 70 feet of line is removed from the drum.

The tables are computed for eight-line reeving, and with a 136-foot derrick. If a taller structure is used, or the stringup involves more than eight lines, the practices shown would not apply, but could be readily converted.

TABLE 1
Practice for Cutting 1¼" 2500 Ft. Rotary Lines I W R C

When Drilling Between Depths	DRILL PIPE DIAMETERS					
	4½"			3½"		
	No. Round Trips Between Drum Cuts	Average Ton Miles Per Round Trip	Average Ton Miles Between Drum Cuts	No. Round Trips Between Drum Cuts	Average Ton Miles Per Round Trip	Average Ton Miles Between Drum Cuts
0— 4,000	20	21	420	..	....	....
4,000— 6,000	15	74	1,110	..	....	....
6,000— 8,000	10	124	1,240	12	109	1,308
8,000— 9,000	8	168	1,344	10	147	1,470
9,000—10,000	7	202	1,414	8	175	1,400
10,000—11,000	6	238	1,428	7	205	1,435
11,000—12,000	5	277	1,385	5	237	1,185
12,000—13,000	4	318	1,272	4	272	1,088

Eight line reeving and 136 ft. derrick requires approximately 1650 ft. of rope.
2500 ft.—1650 ft.=850 ft. or 10 or 12 drum cuts of approximately 70 to 80 ft. in length and near 1400 ton miles between drum cuts—below 6,000 ft. depths.

TABLE 2
Practice for Cutting 1¼" 2500 Ft. Rotary Lines—Fiber Cores

When Drilling Between Depths	DRILL PIPE DIAMETERS					
	4½"			3½"		
	No. Trips Between Cuts	Avg. Ton Miles Per Round Trip	Avg. Ton Miles Between Cuts	No. Trips Between Cuts	Avg. Ton Miles Per Round Trip	Avg. Ton Miles Between Cuts
0— 4,000	15	21	315	..	....	.....
4,000— 6,000	10	74	740	..	....	.....
6,000— 8,000	7	124	968	8	109	872
8,000— 9,000	5	168	840	6	147	882
9,000—10,000	4	202	808	5	175	875
10,000—11,000	4	238	952	4	205	820
11,000—12,000	3	277	831	4	237	948
12,000—13,000	3	318	954	3	272	816

Below 13,000 ft. add one coil from reserve every round trip; then cut 40 ft. after every third round trip
Note: Measure rope cut off to nearest foot and enter on drilling report.
Grooved drums—Maintain 10 to 12 coils of rope on drum when blocks are at lower pick-up position
Weight Factor=20,000 lbs. for ton mile values shown.
Eight line reeving and 136 ft. derrick=approximately 1650 ft. rope.
2500 ft.—1650 ft.=850 or approximately 20 40-ft. cuts.
Average 800 ton miles per cut.

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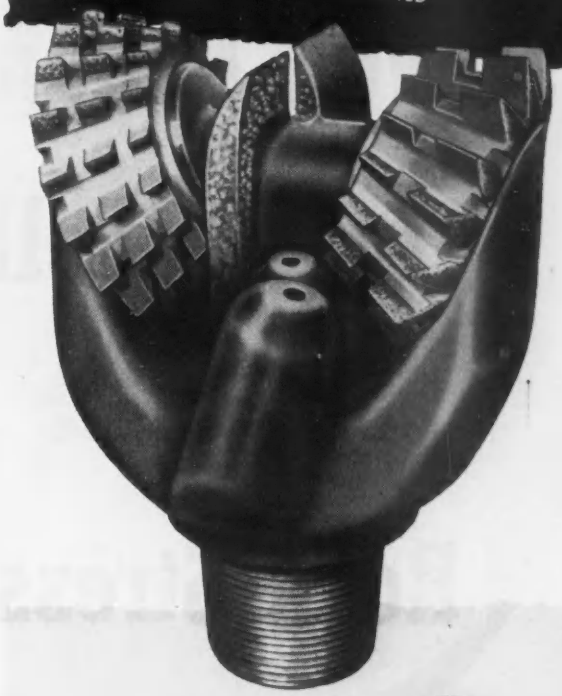

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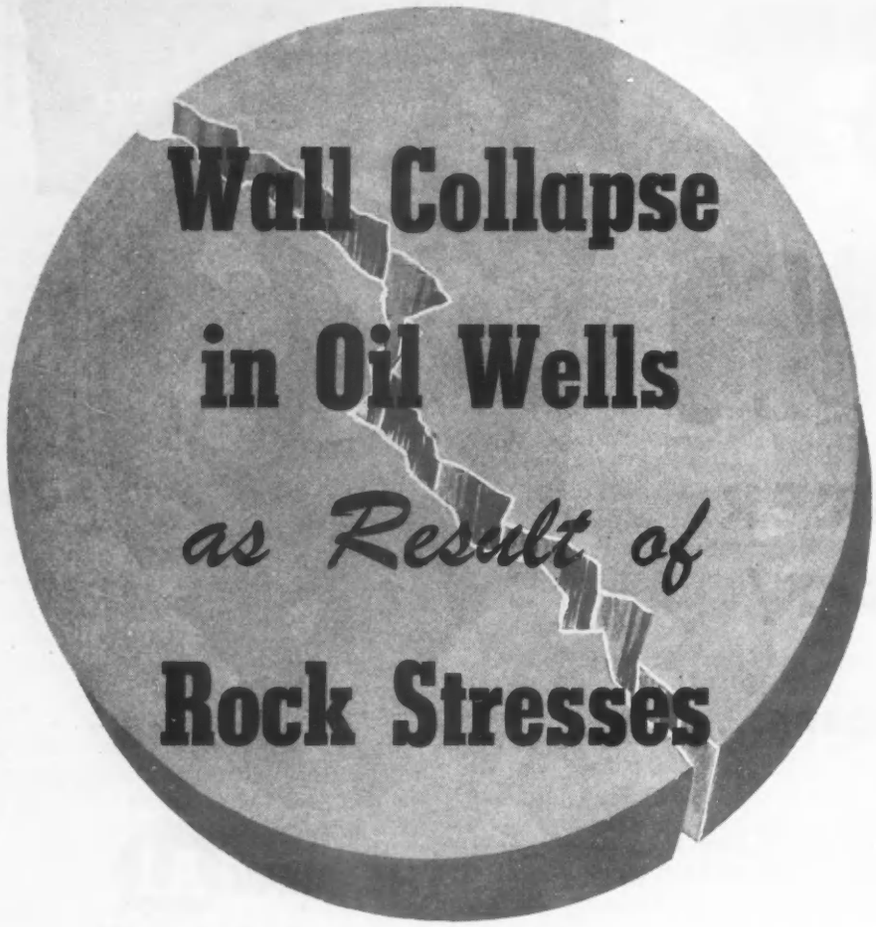

Wall Collapse in Oil Wells as Result of Rock Stresses

By A. D. TOPPING
Assistant Professor of Engineering Mechanics, Purdue University

THERE are two conditions in the drilling of an oil well that may indicate wall collapse: (1) stuck drill pipe, and (2) inability to reach total depth after the drill pipe has been pulled from the hole for some reason, such as to change bits.

Neither of these conditions necessarily indicates wall collapse, as they may be the result of the settling of cuttings around the pipe (in the first case), or at the bottom of the hole (in the second case). Nevertheless, there is good reason to believe that well walls do collapse, particularly in the deep wells which the industry increasingly demands, where the stresses in the rock surrounding the bore hole may approach the strength of the rock.

In order to conceive of this as a possibility, it must be realized that the existence of a hole makes a great difference in the state of stress of a rock stratum. This may be shown by some considerations of the mechanics of materials. For simplicity, suppose rock to be an elastic, isotropic, impervious solid; then the theory of elasticity will apply.

Before the penetration of the drill, there will be a vertical stress, σ_z, equal to the weight of the rock above one square inch of the stratum considered, or ρZ. Since an elastic material tends to expand laterally under compression, a lateral stress is created by the constraint of the surrounding rock. Using cylindrical coordinates, and writing γ for Poisson's ratio,

$$\sigma_r = \gamma\sigma_z + \gamma\sigma_\theta$$
$$\sigma_\theta = \gamma\sigma_z + \gamma\sigma_r \qquad \text{Equations (1)}$$

Solving these two equations simultaneously,

$$\sigma_r = \sigma_\theta = \frac{\gamma}{1-\gamma}\sigma_z \qquad \text{Equations (2)}$$

These are the lateral stresses due to the weight of the overburden before the hole is drilled. There may also exist in some areas a horizontal compression due to such things as shrinkage of the earth (though there seems to be some difference of opinion among geologists on this).

After a hole is drilled, a more complex state of stress exists in the neighborhood of the hole. It can best be determined by considering first several simpler cases from the theory of elasticity, of which only the results will be given here, and then by combining them by use of the principle of superposition.

If the stress distribution is assumed to be symmetrical, the bore hole may be considered as the inside of a cylinder with very thick walls—approaching an infinite thickness. Therefore, the following equations for the stresses in a thick-walled hollow cylinder apply. For a uniform external pressure, p_o (Figure 1):

$$\sigma_r = \frac{Po\,b^2}{b^2-a^2}\left(\frac{a^2}{r^2}-1\right)$$
$$\sigma_\theta = \frac{-b^2\,Po}{b^2-a^2}\left(\frac{a^2}{r^2}+1\right)$$
$$\tau_{max.} = \pm\frac{Poa^2b^2}{r^2(b^2-a^2)} \qquad \text{Equations (3)}$$

If the external radius, b, is large in comparison with the internal radius, a, the stresses approach the values:

$$\sigma_r = P_o\left(\frac{a^2}{r^2}-1\right)$$
$$\sigma_\theta = -P_o\left(\frac{a^2}{r^2}+1\right)$$
$$\tau_{max.} = \pm\frac{Po\,a^2}{r^2} \qquad \text{Equations (4)}$$

These equations are plotted in Figure 2. At the inside, equations (4) reduce to:

$$\sigma_r = O$$
$$\sigma_\theta = -2\,p_o$$
$$\tau_{max.} = \pm\,po \qquad \text{Equations (5)}$$

The stresses due to an internal pressure, p_i, in a thick-walled cylinder are:

$$\sigma_r = \frac{Pi\,a^2}{b^2-a^2}\left(1-\frac{b^2}{r^2}\right)$$
$$\sigma_\theta = \frac{Pi\,a^2}{b^2-a^2}\left(1+\frac{b^2}{r^2}\right)$$
$$\tau_{max.} = \pm\frac{Pi\,a^2\,b^2}{r^2\,(b^2-a^2)} \qquad \text{Equations (6)}$$

If the external radius, b, is large in comparison with the internal radius, a, the stresses approach the values:

$$\sigma_r = -\frac{Pi\,a^2}{r^2}$$
$$\sigma_\theta = +\frac{Pi\,a^2}{r^2}$$
$$\tau_{max.} = \pm\frac{Pi\,a^2}{r^2} \qquad \text{Equations (7)}$$

These equations are plotted in Figure

MATHEMATICAL PROOF is presented of the possibility of collapse of a deep well bore through the combination of rock stresses and/or the reduction of internal pressures, as when a drill string is lifted. Hydrostatic pressure in porous formations is indicated as a contributing cause when a pressure drop occurs within the well. The theory covers many cases of lost circulation when drilling in formations known to be not cavernous.

3. At the inside surface, they reduce to:

$$\sigma_r = -\,pi$$
$$\sigma_\theta = +\,pi$$
$$\tau_{max.} = \pm\,pi \qquad \text{Equations (8)}$$

Since the sum, $\sigma_r + \sigma_\theta$, from **equations** (3) through (8) is always a constant, any longitudinal extension or contraction of the cylinder according to Poisson's law will be constant; that is, there will be no local thickening around the hole.

Now consider the actual case of an oil well, leaving aside for the present consideration of stresses from any cause except the weight of the overburden and the fluid pressure in the bore hole. According to the principle of St. Venant, the presence of the borehole will have no effect at large distances from the hole; therefore, the rock around the hole may be considered as a large, thick-walled cylinder subjected to an external pressure equal to σ_r as given by equations (2), an internal pressure, p_i, in the borehole, and a longitudinal (vertical) stress, $\sigma_z = -\rho z$. Inspection of Figures 2 and 3 shows that the stresses are most critical at the inner face of the cylinder —that is, at the borehole—which, of course, is where collapse would occur. Superposing the effects of the three factors there, using equations (5) and (8),

$$\sigma_r = -\,pi$$
$$\sigma_\theta = pi - \frac{2\gamma\rho z}{1-\gamma}$$
$$\sigma_z = -\rho z \qquad \text{Equations (9)}$$

In these equations, z, the depth below the surface, is considered as positive; then plus signs indicate tensile stress and minus signs compressive stress. Each of the three maximum shearing stresses is equal to half the difference of one pair of normal stresses (since these are principal stresses), and acts on the pair of planes making 45 degrees with the corresponding pair of principal planes.

Figure 4 shows the three principal stresses and the maximum shearing stresses plotted against the depth, z. Here the weight of the overburden, ρ, is assumed to amount to one pound per foot of depth per square inch; Poisson's ratio is taken as 0.25; and the fluid pressure is taken as 0.8 of the overburden pressure (this corresponds to the static head of a fluid with a specific gravity of about 1.8).

A comparison of the results for a given depth with Table 1 indicates that the rock around the well should be expected to fail in tension or shear long before the compressive strength of the material has been exceeded. Figures 2 and 3 show that σ_θ is tensile only very close to the hole; nevertheless, a vertical crack might be opened in the well wall, and the pressure of the fluid seeping into such a crack would tend to extend it farther and farther away from the well. Since the maximum lateral compression in the rock from equations (2) is always less than the assumed fluid pressure, there is nothing in theory to prevent the crack from extending itself indefinitely so long as the fluid pressure is maintained. Loss of fluid into the crack might cause a pressure drop. Unexplained pressure drops sometimes occur during drilling.

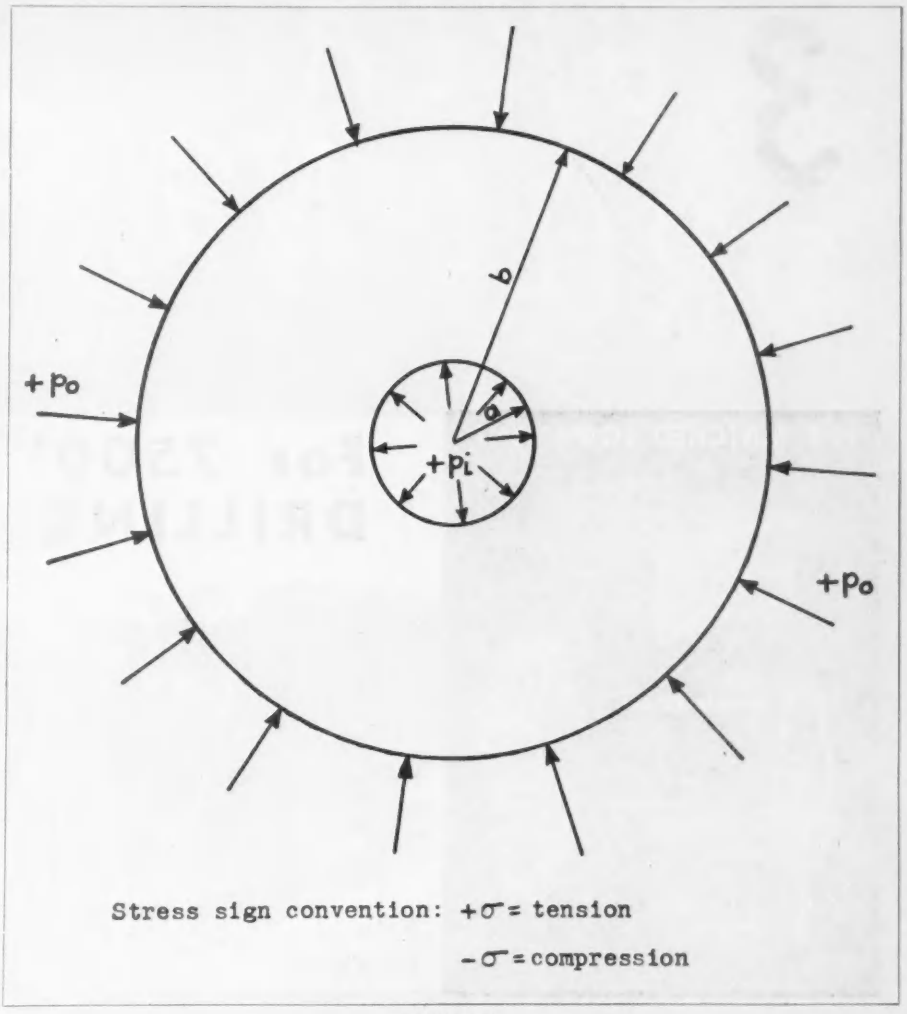

FIGURE 1

The appearance of tension cracks, however, would not seem likely to be a direct cause of wall collapse. More probably, that is primarily a shear failure. Consider a small wedge-shaped element at the boundary of the hole, the base of the wedge being at the surface of the hole. If the two sloping faces of the wedge make 45 degrees with the vertical, there is a tendency to expel the little wedge into the hole when σ_z becomes large, which is resisted only by the shearing forces on the sloping faces of the wedge (σ_r and the fluid pressure cancel each other out, and there are no shearing stresses on the other faces since they are principal planes), which equal $\frac{\sigma_z - \sigma_r}{2}$. If the wedge is turned through 90 degrees with the base still at the well face, the shearing stress is equal to $\frac{\sigma_\theta - \sigma_r}{2}$, but since σ_θ is tension, there is no tendency to expel the element. Nor would there be a tendency to expel an elementary wedge turned so that the shearing stress was $\frac{\sigma_z - \sigma_\theta}{2}$ or the maximum of the three maximum shears at a point on the well face. Hence the critical maximum shear appears to be $\frac{\sigma_z - \sigma_r}{2}$. If shear failure occurred on the other 45 degree planes, the pieces might very well stay in position, like masonry laid without mortar; only when failure occurred on the third set of 45 degree planes would they be popped into the hole.

Since $\frac{\sigma_z - \sigma_r}{2}$ is the smallest of the three maximum shearing stresses, failure might be presumed to have occurred on the other planes already by the time it occurs on the critical planes; but the pieces could still be held in place by friction. A force summation, using a small wedge as a free body, shows that the minimum coefficient of friction, μ, required for equilibrium is $\frac{\sigma_z - \sigma_r}{\sigma_z + \sigma_r}$; and if $\sigma_r = \delta\,\sigma_z$, as in Figure 4, this amounts

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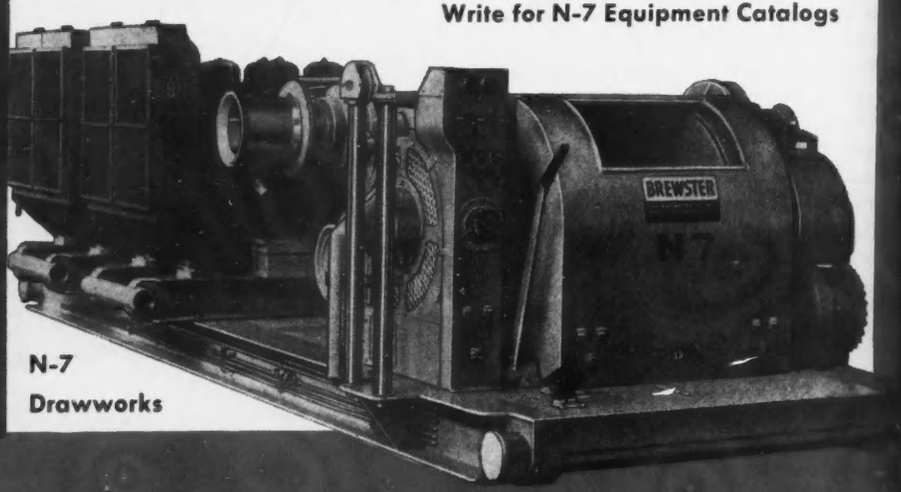

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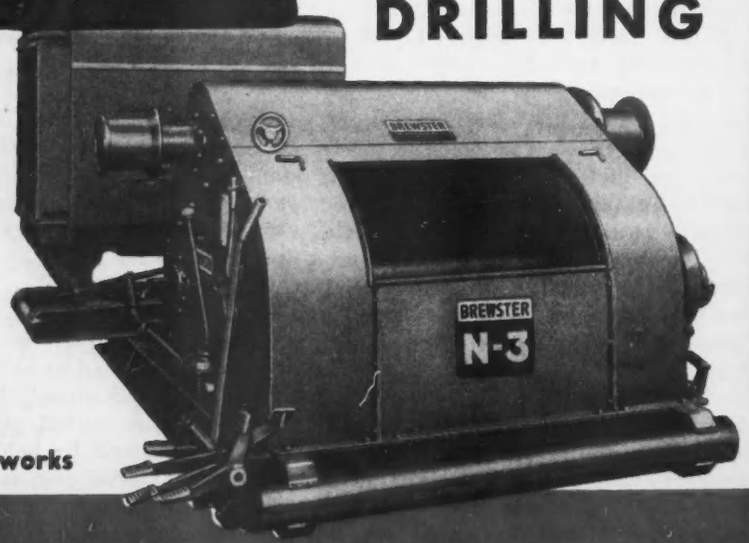

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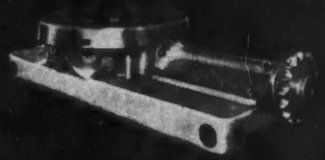

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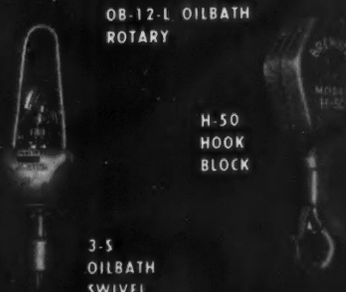

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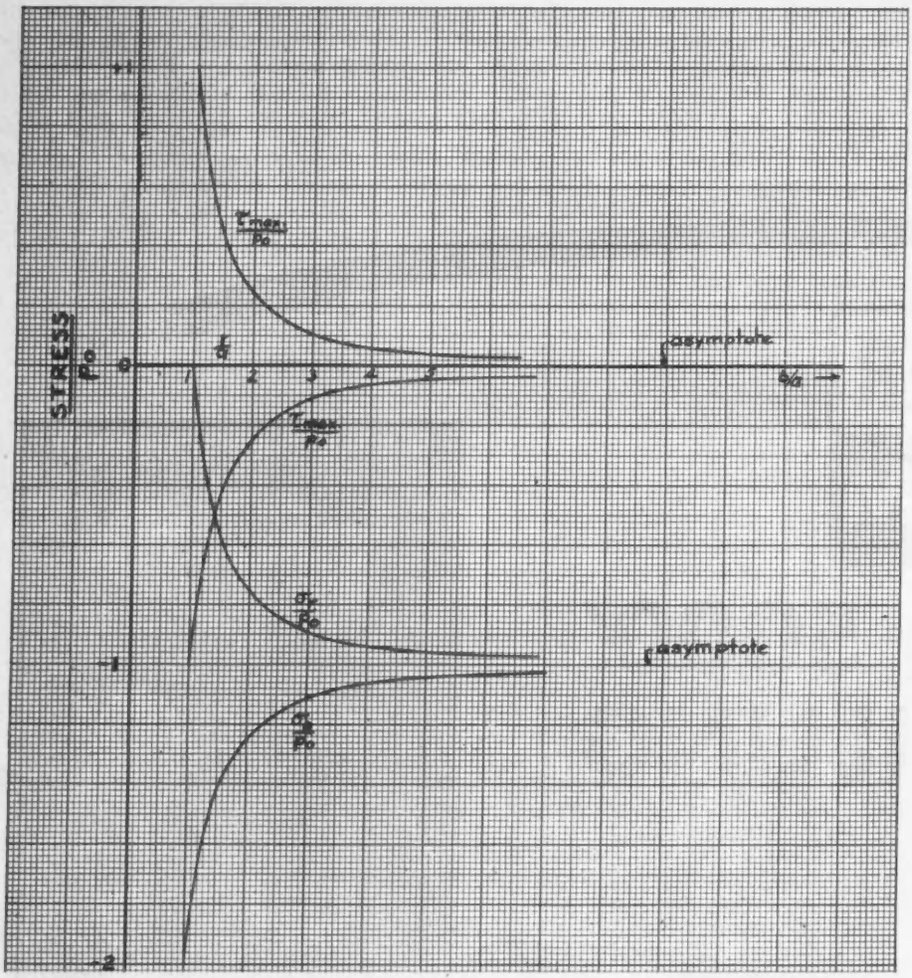

FIGURE 2. Stress variation in a hollow cylinder as a function of the distance from the center when the internal pressure is zero, and the external radius is large in comparison with the inner radius.

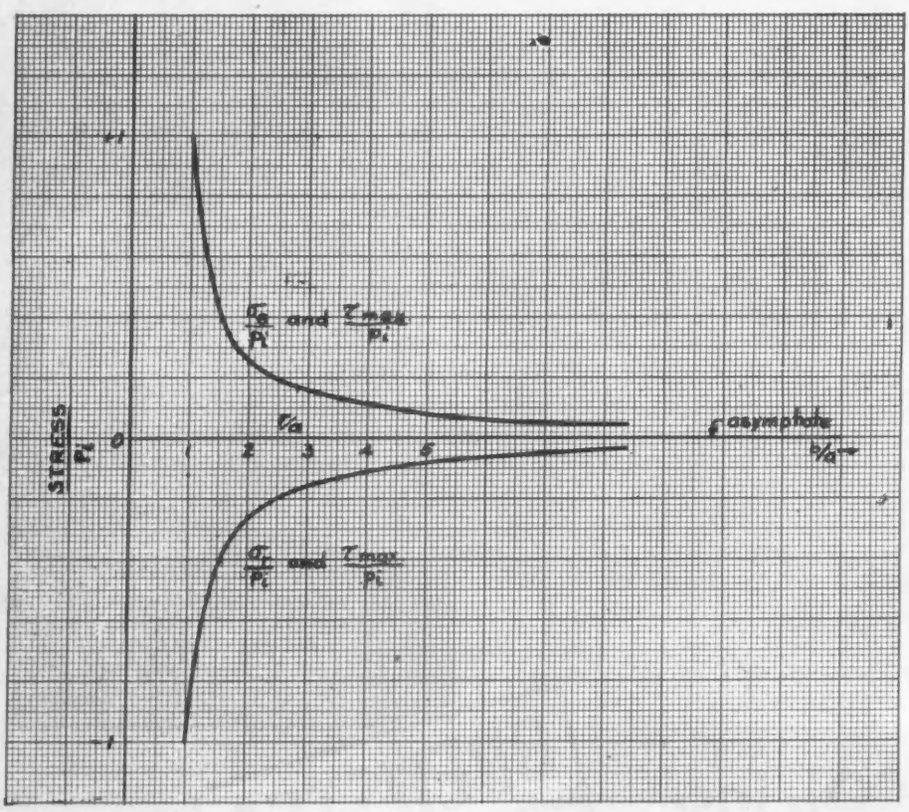

FIGURE 3. Stress variation in a hollow cylinder as a function of the distance from the center when the external pressure is zero, and the external radius is large in comparison with the inner radius.

to only about 0.11. If μ were 0.25, say, for the rock in question, wall collapse might not occur at all, until or unless the pressure is 25 percent less than was assumed for Figure 4. A lower fluid pressure also gives higher stresses on the critical shear plane. The ideal would be to have the fluid pressure exactly equal to the weight of the overburden.

If the above analysis is correct, and it seems to be in better agreement with what is known about the properties of rocks and with what has happened in actual cases than the assumption that wall collapse occurs as soon as the shearing strength of the material has been reached, it may be well worth considering whether the pressure inside the bore hole is not reduced by the swabbing action of the bit when it is pulled out, and whether wall collapse does not occur at that time. Unfortunately, no one seems to have any very good idea as to how much such a reduction in pressure might be. If the weight of the parts being lifted out of the well were known, however, the pressure drop might be determined by means of strain gauges on the hoisting equipment or on the derrick. In a six-inch diameter hole, for example, a decrease of 1000 pounds per square inch in the fluid pressure below the bit would cause an additional load of 28,300 pounds on the hoist.

Now consider the effect of a pre-existing horizontal compressive stress in one direction of the rock stratum, again using results from the theory of elasticity. In a semi-infinite plate, or stratum, having a circular hole and subjected to a uniform stress in one direction, S, perpendicular to the axis of the hole, the stresses are:

$$\sigma_r = \frac{S}{2}\left[1 - \frac{a^2}{r^2} + \cos 2\theta \left(1 - 4\frac{a^2}{r^2} + 3\frac{a^4}{r^4}\right)\right]$$

$$\sigma_\theta = \frac{S}{2}\left[1 + \frac{a^2}{r^2} - \cos 2\theta \left(1 + 3\frac{a^4}{r^4}\right)\right]$$

$$\tau_{r\theta} = -\frac{S \sin 2\theta}{2}\left(1 + 2\frac{a^2}{r^2} - 3\frac{a^4}{r^4}\right)$$

Equations (10)

A plot of this stress distribution may be found on Page 101 of "Plasticity," by A. Nadai. At the edge of the hole, where $r = a$,

$$\sigma_r = O$$

$$\sigma_\theta = S - 2S\cos 2\theta$$

$$\tau_{r\theta} = O$$

Equations (11)

The maximum stress here occurs when $\theta = \frac{\pi}{2}$ or $\frac{3\pi}{2}$, which gives $\sigma_\theta = 3S$. This stress concentration is on a line

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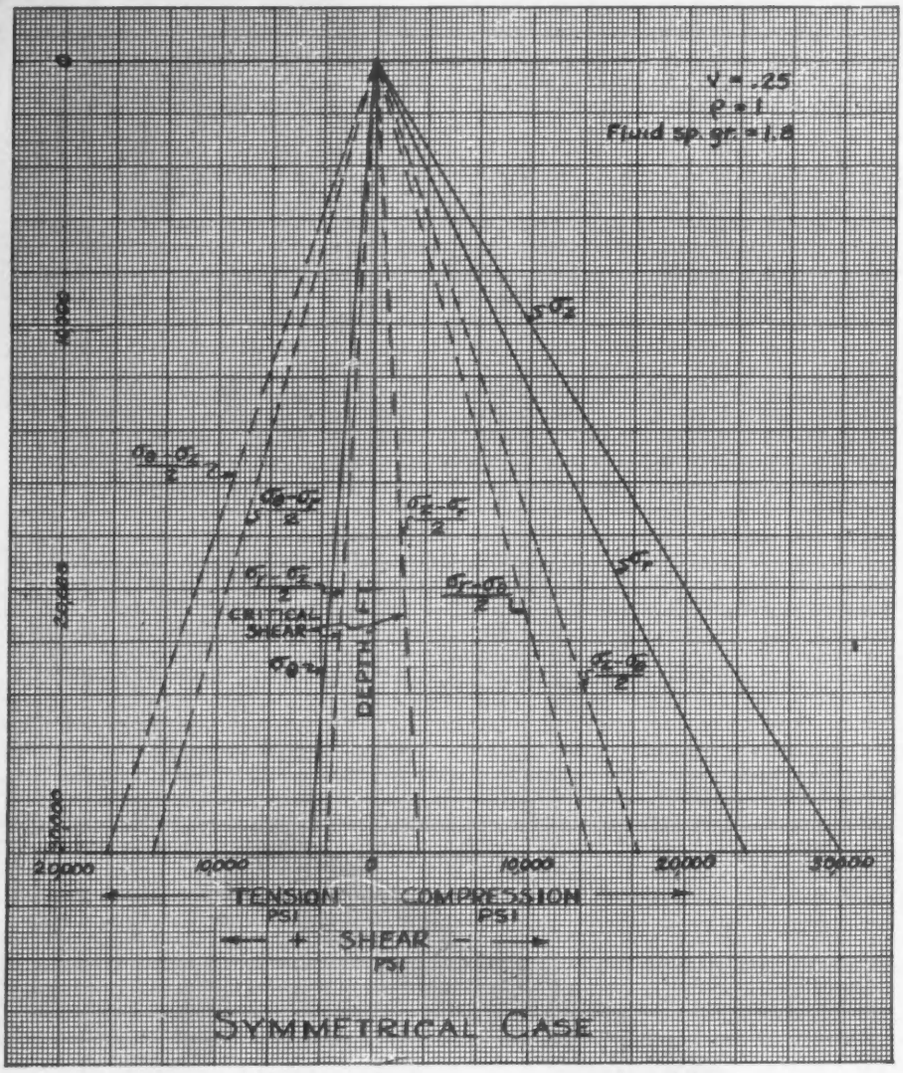

FIGURE 4. Variation of stresses with depth.

through the center of the hole perpendicular to the direction of S. The general equations for stress on this line are:

$$\sigma_r = \frac{3S}{2}\left(\frac{a^2}{r^2} - \frac{a^4}{r^4}\right)$$

$$\sigma_\theta = \frac{S}{2}\left(2 + \frac{a^2}{r^2} + 3\frac{a^4}{r^4}\right)$$

$$\tau_{r\theta} = O$$

Equations (12)

Other important points at the edge of the hole are where $\theta = O$ or π. There, $\sigma_\theta = -S$, which means that if S is compressive, σ_θ is a tensile stress. The general equations for stress along this line, parallel to the direction of S, are

$$\sigma_r = \frac{S}{2}\left(2 + 3\frac{a^4}{r^4} - 5\frac{a^2}{r^2}\right)$$

$$\sigma_\theta = \frac{S}{2}\left(\frac{a^2}{r^2} - \frac{3a^4}{r^4}\right)$$

$$\tau_{r\theta} = O$$

Equations (13)

Equations (12) and (13) are plotted in Figure 5. $\tau_{max.}$ is plotted also; since σ_r and σ_θ are principal stresses along these two lines, it is equal to $\frac{\sigma_r - \sigma_\theta}{2}$.

Because $\sigma_r + \sigma_\theta$ is not a constant, as it was for the symmetrical case, the strata will tend to thicken more at some places than at others, and even tend to become thinner at some points where tensile stresses occur. This variation in thickness would be

$$\Delta\varepsilon_z = \frac{\gamma}{E}\left(\sigma_r + \sigma_\theta - S\right)$$

Equations (14)

inches per inch of thickness of the strata. In strata several hundred feet thick, this would amount to several inches.

Any such expansion or contraction would be a strictly local phenomenon, occurring only very close to the bore hole. As no swellings or depressions are observed to be created about boreholes during drilling, it seems a reasonable assumption that the resistance of the overlying layers prevents any appreciable local change in thickness. In that case, the tendency to expand or contract causes an increment of stress. If lateral deformation is also prevented,

$$\Delta\varepsilon_z = \Delta\varepsilon_r = \Delta\varepsilon_\theta = O,$$

and the increase in stress is

$$\Delta\sigma_z = \frac{\gamma\,(1\text{-}\gamma)}{(1-2\gamma)\,(1+\gamma)}(\sigma_{r_o} + \sigma_{\theta_o} - S)$$

$$\Delta\sigma_r = \Delta\sigma_\theta = \frac{\gamma^2}{(1-2\gamma)\,(1+\gamma)}(\sigma_{r_o} + \sigma_{\theta_o} - S)$$

Equations (15)

At the edge of the hole, however, $\Delta\sigma_r$ must obviously be zero. If $\Delta\varepsilon_\theta$ is still zero,

$$\Delta\sigma_z = \frac{\gamma}{1-\gamma^2}(\sigma_{r_o} + \sigma_{\theta_o} - S)$$

$$\Delta\sigma_\theta = \frac{\gamma^2}{1-\gamma^2}(\sigma_{r_o} + \sigma_{\theta_o} - S)$$

$$\Delta\sigma_r = O$$

Equations (16)

If no lateral constraint whatever is assumed,

$$\Delta\sigma_z = \gamma\,(\sigma_{r_o} + \sigma_{\theta_o} - S)$$

$$\Delta\sigma_r = \Delta\sigma_\theta = O$$

Equations (17)

There is not a great deal of difference in these three cases, as may be seen by substituting an average value of Poisson's ratio, γ, of 0.25 into the equations and remembering that they give only increments of stress. For instance, the maximum stress at the edge of the hole, from equations (16) and (12), is 3.13S; from (17) and (12), 3S.

The stresses due to a horizontal compressive stress in one direction must now be superposed upon the stresses due to overburden and to fluid pressure within the well. Thus the total stresses at the edge of the hole where $\theta = \frac{\pi}{2}$ or $\frac{3\pi}{2}$ are, when S is taken minus for compression [eqs. (9) + (11) + (16)]:

$$\sigma_r = -\text{pi}$$

$$\sigma_\theta = \text{pi} - \frac{2\gamma\rho z}{1-\gamma} - 3S - \frac{\gamma^2}{1-\gamma^2}(2S)$$

$$\sigma_z = -\text{pz} - \frac{\gamma}{1-\gamma^2}(2S)$$

Equations (18)

and where $\theta = O$ or π,

$$\sigma_r = -\text{pi}$$

$$\sigma_\theta = \text{pi} - \frac{2\gamma\text{pz}}{1-\gamma} + S + \frac{\gamma^2}{1-\gamma^2}(2S)$$

$$\sigma_z = -\text{pz} + \frac{\gamma}{1-\gamma^2}(2S)$$

Equations (19)

Equations (18) and (19) are plotted in Figures 6 and 7 respectively, along with the maximum shearing stresses, for S = 5000 psi, other data being the same as for Figure 4. Considering Figure 7 first, it is seen that, in general, the state of stress represented is similar to the

symmetrical case of Figure 4, but that the stresses are larger—with the vital exception of the critical shearing stress, $\frac{\sigma_z - \sigma_r}{2}$, which (disregarding a portion near the surface of the ground) is actually smaller.

At the other sides of the hole, an entirely different state of stress, represented in Figure 6, exists. All three principal stresses are compressive. Considering little wedges as before, we see that both σ_z and σ_θ are tending to **expel** bits into the borehole. The critical shearing stress will be the smaller of $\frac{\sigma_z - \sigma_r}{2}$ and $\frac{\sigma_\theta - \sigma_r}{2}$, for $\frac{\sigma_z - \sigma_\theta}{2}$ does act on a plane on which failure would contribute to wall collapse. There appears to be a danger zone at about ten or twelve thousand feet; that passed, one might drill for a couple of miles before the critical shear again approaches the shearing strength of the rock.

Friction must be overcome before wall collapse takes place, however. A small wedge will have friction on both the sloping faces and the ends this time, and a pyramid-shaped piece might be more likely to be squeezed out. If the sloping faces make 45° with the base, the minimum coefficient of friction necessary for equilibrium is $\frac{\sigma_z + \sigma_\theta - 2\sigma_r}{\sigma_z + \sigma_\theta + 2\sigma_r}$. In Figure 6 at 10,000 feet, this would be about 0.26.

The behavior of materials under tri-axial stress, particularly tri-axial compression, is sometimes astounding to one accustomed to stress-strain curves based on uni-axial tests. The above analysis assumes that rock is brittle; yet von Karman and others have made tests showing that marble, for instance, behaves plastically under certain conditions of tri-axial compression. When the three compressive principal stresses are held equal, no evidence of failure at all has been observed within experimental limits, and there is reason to believe failure would never occur under such conditions. As Figure 6 indicates that the normal stresses at this part of the hole are of similar magnitudes, plastic deformation may take place before shearing fracture. If so, the stress condition is less serious than the elastic analysis indicates. Then the pre-existing horizontal compressive stress would appear

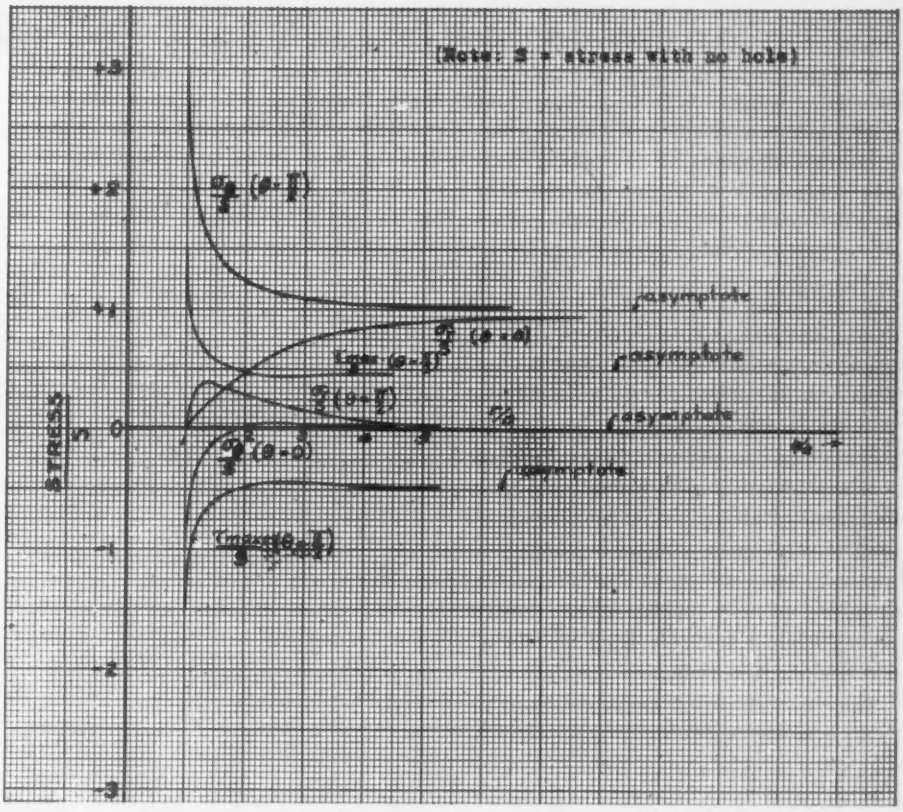

FIGURE 5 (Top). Variation of maximum stresses in a plate having a hole of radius a and loaded in one direction in its plane.

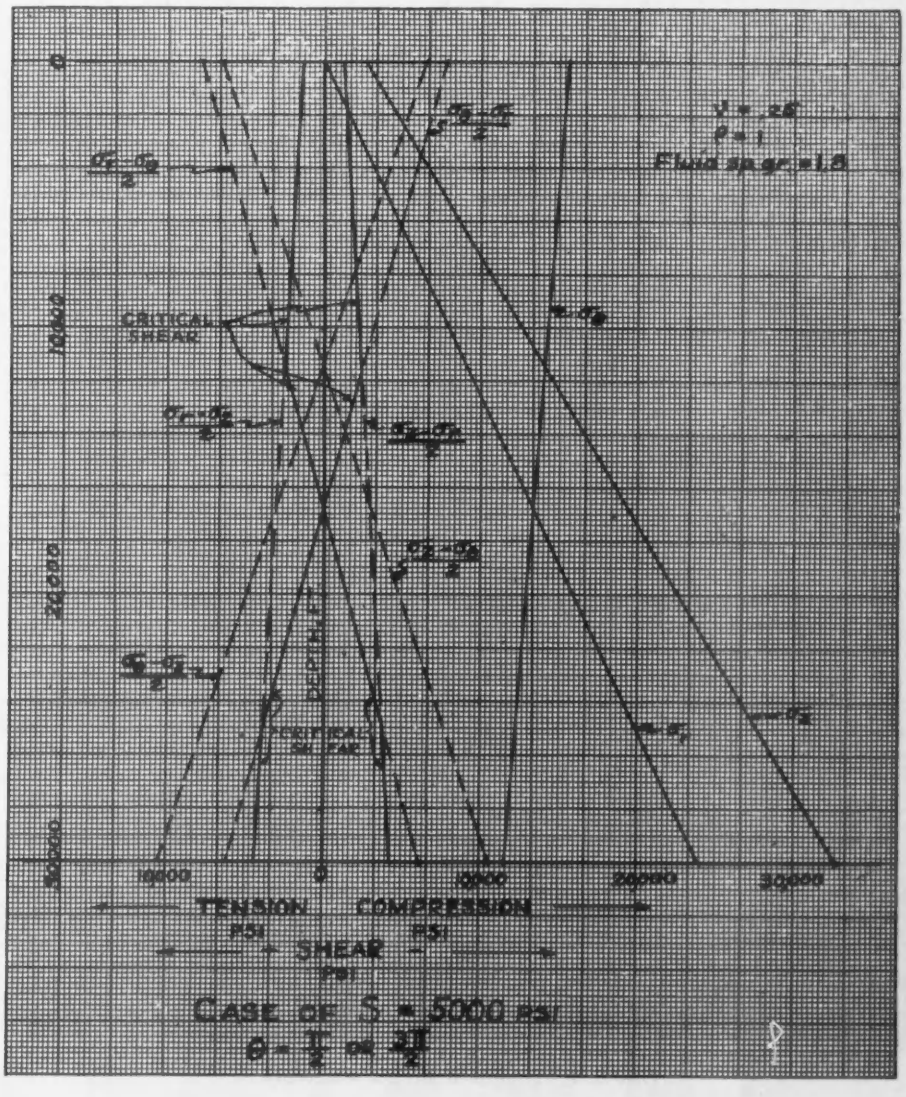

FIGURE 6 (Below). Variation of stresses with depth.

to have no important effect on wall collapse.

Now examine the assumptions that have been made. That stone conforms to Hooke's law is not strictly true; tentative investigations by the author indicate that the law of deformation may be satisfactorily written as $k\delta^n$, where $\delta = \varepsilon - \frac{\sigma}{E}$, and k and n are constants. The deviation is not great enough to affect the analysis qualitatively, however, except as discussed above; nor does the anisotropy of sedimentary rock appear likely to cause serious error.

If the rock is porous, the hydrostatic pressure of the absorbed fluid will be a contributing factor in wall collapse in case of a drop in pressure within the borehole. An analogous example is the sloughing of river banks, which always occurs while the water level is falling, never while it is rising.

The coefficient of friction given in Table 1 is for dry stone; undoubtedly it is smaller for wet surfaces. Furthermore μ is constant only for relatively small variations in pressure, and decreases as the pressure increases.

In conclusion, then, wall collapse is most likely to occur when the fluid pressure in the well is low. Heavy drilling mud helps prevent it. Suction below the bit when it is being pulled out is probably a common source of wall collapse.

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SYMBOLS

r, θ, z	Cylindrical coordinates.
σ_r, $\sigma\theta$, σ_z	Components of normal stress in cylindrical coordinates.
τ	Shearing stress.
$\tau_r\theta$, τ_{rz}, $\tau\theta_z$	Shearing stress components in cylindrical coordinates.
a	Inside radius of a hollow cylinder, or of a borehole.
b	Outside radius of a hollow cylinder.
p_o	External pressure on a hollow cylinder.
p_i	Internal pressure on a hollow cylinder.
S	Initial uniform stress perpendicular to the axis of a hole in a plate.
ε_r, $\varepsilon\theta$, ε_z	Unit elongations in cylindrical components.
ρ	Weight of overburden per foot of depth per square inch of area.
ν	Poisson's ratio.
μ	Coefficient of friction.
E	Modulus of elasticity in tension or compression.
psi	Pounds per square inch.
Δ	Increment.

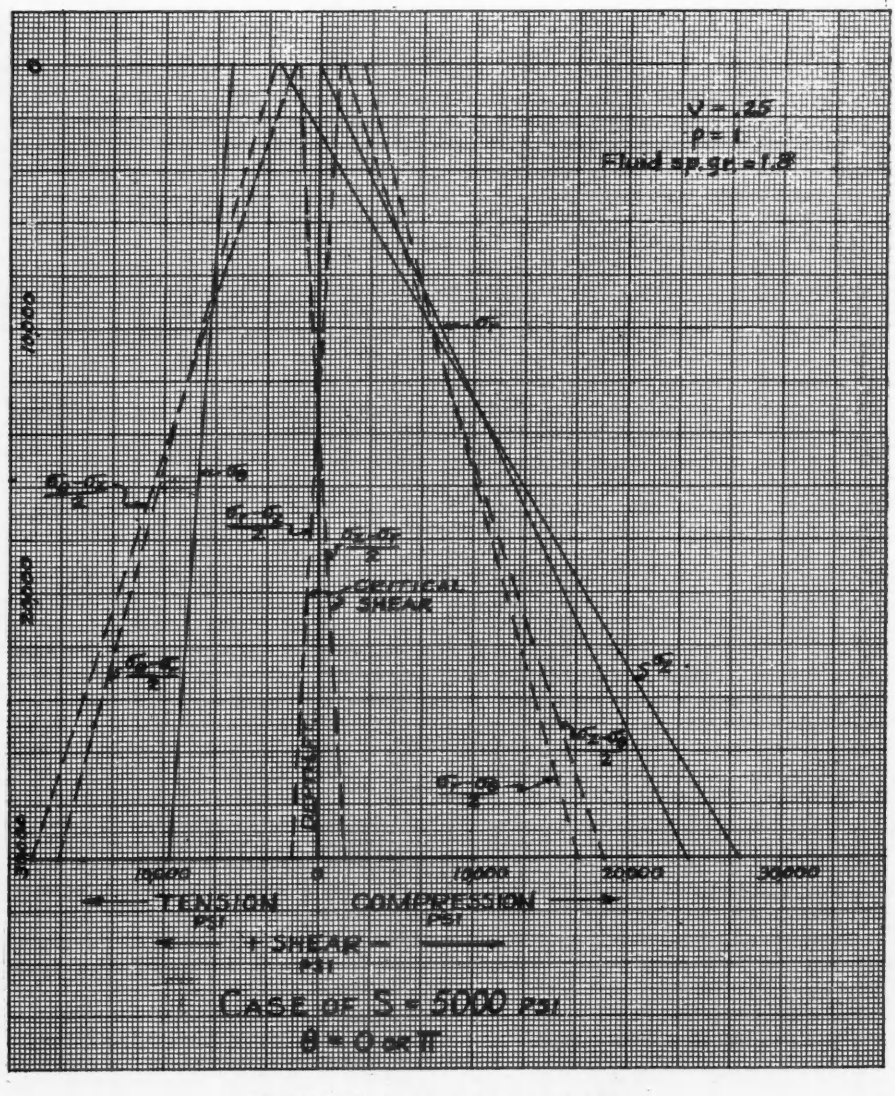

FIGURE 7. Variation of stresses with depth.

TABLE 1

Rock Type	Average Ultimate Compressive Strength, psi	Average Ultimate Tensile Strength, psi	Average Ultimate Shearing Strength, psi	Poisson's Ratio (ν)	Coefficient of Friction (μ)
Marble....	13000	450	1300	0.27	
Limestone..	9000	300	1350	0.26	0.40
Sandstone..	11000	200	1200	0.23	to
Granite....	20000	650	2000	0.21	0.65 (dry)

Values in this table, except for the coefficient of friction, are approximate averages of values from Table 4, p. 255, of *Johnson's Materials of Construction*, 8th ed., by J. B. Johnson, M. O. Withey, and James Aston. Values for all mechanical properties of stone vary widely with different specimens; the compressive strength of limestone, for instance, may vary from 4000 to 20,000 psi. Consequently, for accurate results, samples of rock from the place in question should be tested.

About the Author

A. D. TOPPING, assistant professor of engineering mechanics at Purdue University since 1947, was graduated from that institution in 1939 and after a short period with the American Bridge Company, became instructor in mechanics at the Missouri School of Mines and Metallurgy. In 1944 he joined the Goodyear Aircraft Corporation as a stress analyst. Shortly after the war he became interested in oil well stress problems and has devoted considerable time to this work.

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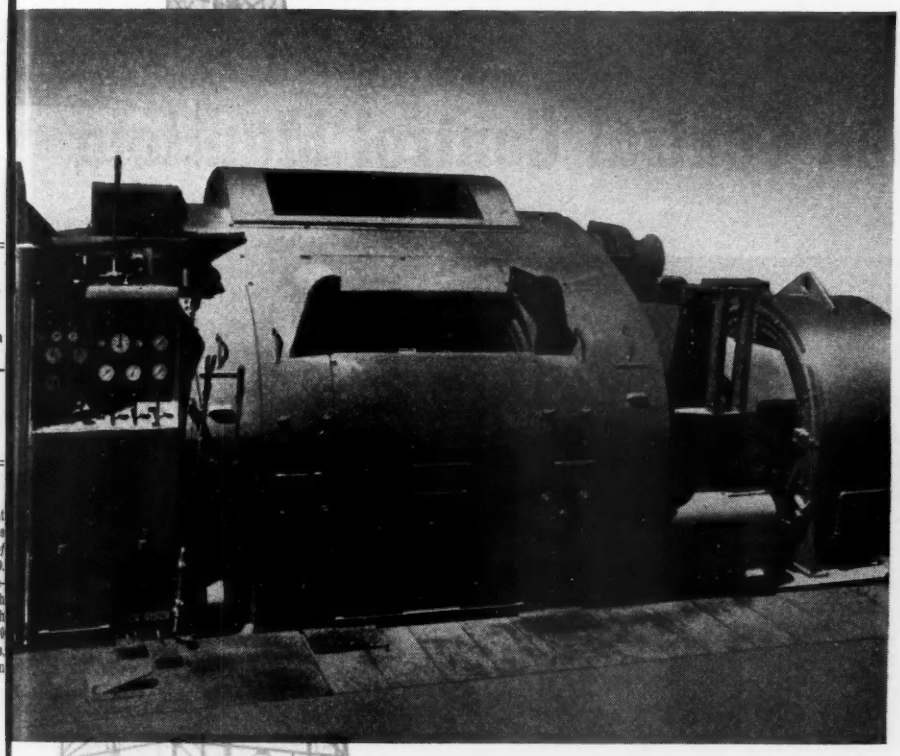

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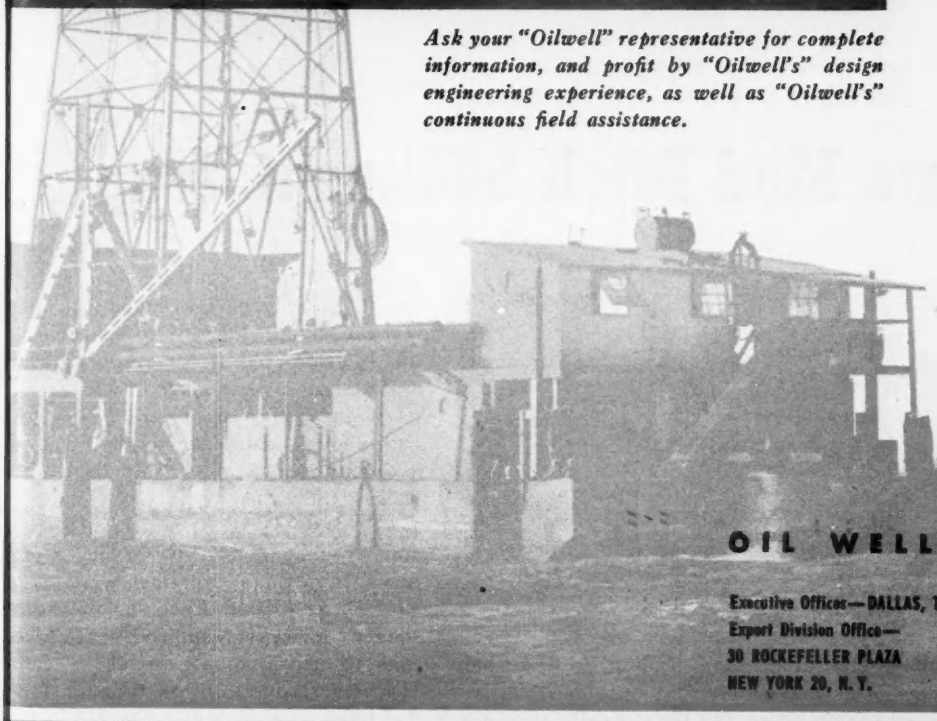

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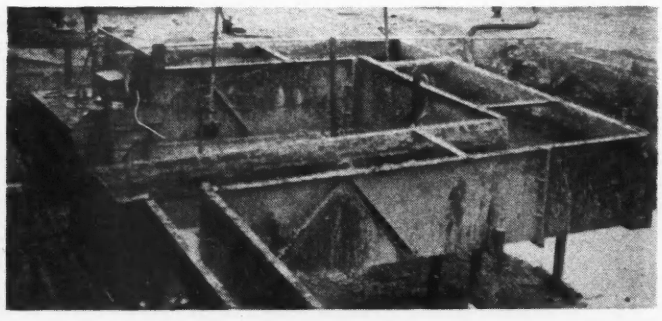
HOW TO—Skid-Mount Central Control Manifold

A centralized control manifold for the entire mud system on one drilling rig features simplicity, ease of installation, visual operation and considerable savings in mud lines. Instead of all lines handling drilling fluid leading back to the mud pumps, only one line leads up to this manifold, which is the discharge line from the mud pumps.

The manifold illustrated was located at the most strategic point between the derrick floor and the mud pumps. From this central point, lines lead to mud guns for each of two pits, to the mud hopper for mixing new mud, and to the standpipe. An additional connection is provided from the manifold for special purposes.

The complete unit is skid-mounted in order that the valves need not be broken from the line every time the rig is moved. Hammered union connections speed installation and break down of the assembly from the mud system. The skid is made from three-inch pipe, welded into the form of a rectangle. An A-frame brace was welded near each end, terminating with a collar at the apex of the brace. Short 2½-inch pipe nipples fit through these collars which hold the manifold to the skid. The assembly is simple to construct, and incorporates many time-saving features. From this central point, one man can quickly control the flow of mud from the mud pumps, since he is at a vantage point where he can see what is happening at the terminus of each mud line.

HOW TO—Fabricate Mud Ditch Sediment Trap



Sand and other finely-divided solids have been satisfactorily removed from the mud stream with an enlargement in the mud ditch which acts as a sediment trap. The trap is all steel, constructed so it may be mounted and dismounted when using removable pipe supports for a substructure. It is formed in a U shape so that one leg matches with the pipe carrying the returns from the well and the other leg is fitted with an opening to attach the steel mud ditch leading to the shale shaker assembly.

Bottom of the U is usually placed at the edge of the shale pit so that when an accumulation of sand and heavy precipitates partly fills the sediment trap, they can easily be raked away through vertical sliding doors. The space inside the U is floored with safety walkway grating so a man may walk around when inspecting or cleaning the trap with a long-handled shovel that is stored in a convenient scabbard attached to the wall of the unit.

The trap is constructed in such a manner that it can be either broken down into three separate sections, or handled as a unit. Each leg of the U-shaped device is equipped with lifting eyes to accommodate hooks or cable. If it is desirable to break the unit down, the bolted flanges on each leg can be disconnected. The sediment trap is easy to build, install, and does not require special design of the mud system.

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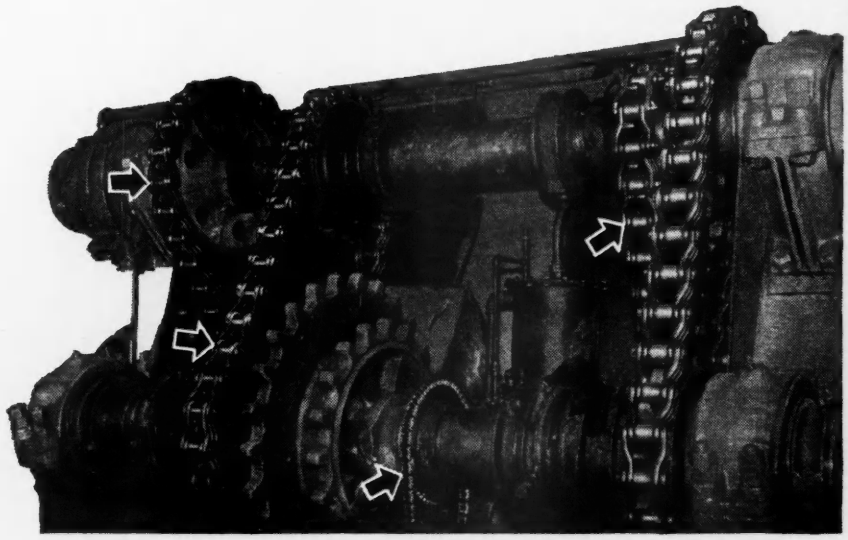

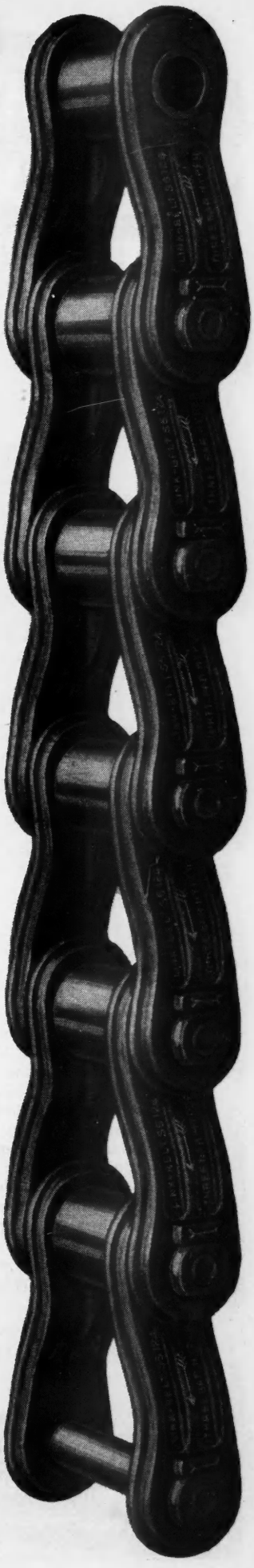

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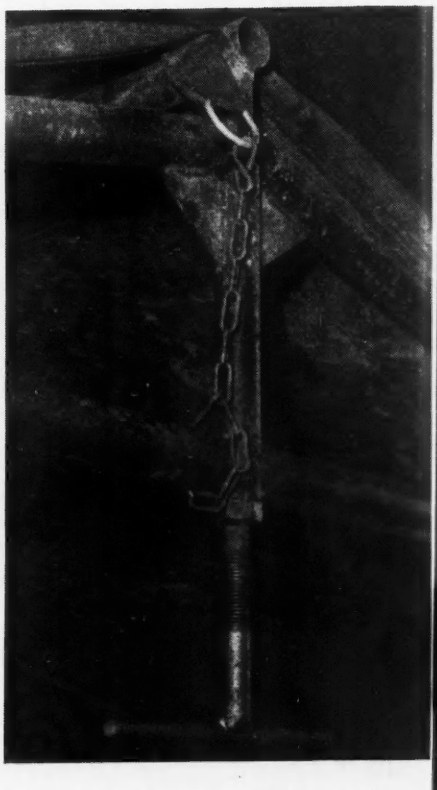
HOW TO—Maintain Tension in Canvas

Canvas housing of drilling equipment has been employed effectively to protect the equipment from sun and rain. One problem encountered when this type housing is used is that of stretching the canvas roof. In time, weather conditions cause the heavy canvas to sag in the unsupported areas, and during rains, water accumulates in the low part. If left unheeded, the pool of water held by the canvas roofing will begin to leak through and wet the equipment below.

A simplified method of taking up stretch in the roofing was incorporated in the tubular framework for the housing illustrated. The tubular rafters, joists and beams are made from two-inch pipe and welded in sections to facilitate erection and tearing down. At the apex of each rafter section this special device for maintaining a tight canvas roof was employed. The horizontal runner that forms the peak of the roof and supports the canvas is welded to a short vertical section of smaller pipe which telescopes inside a larger vertical pipe bracing the rafters.

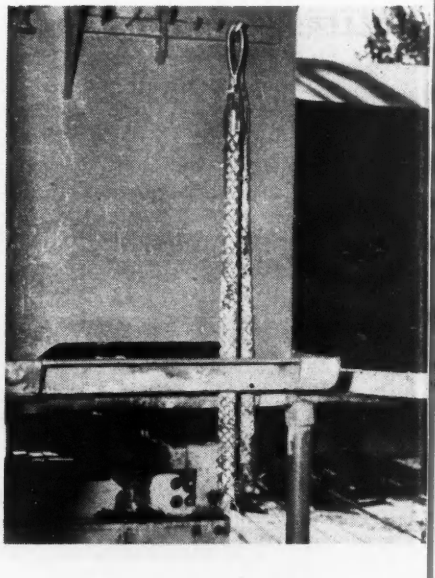


To the horizontal ceiling beam was welded a large nut, which fitted a long screw stem running up into the vertical brace as shown. This screw stem fit into the base of the small piece of pipe which telescoped into the supporting riser and which took the load of the horizontal beam. A handle was welded to the lower end of the screw stem so that by turning the screw to the right, the vertical telescoping pipe would be forced upward and thereby place more tension in the canvas roof.

HOW TO—Care for Wire Rope Grips

Wire rope grips or cable connectors suffer much abuse when not in use. Since they are extremely valuable in reeving the drilling line through the crown and travelling blocks, using the catline, they find use only when rigging up or when replacing an old drilling line with a new one. It is during this idle time that they are misplaced, bent up, and many times ruined.

A simple method of caring for these wire line grips is illustrated. It employs a spare axe or sledge hammer handle which is normally kept in stock on the rig. These handles are inserted into the gripper as shown and the assembly is hung from a convenient nail or peg. The wooden handle maintains the shape of the wire line grip, insuring its usefulness whenever needed.



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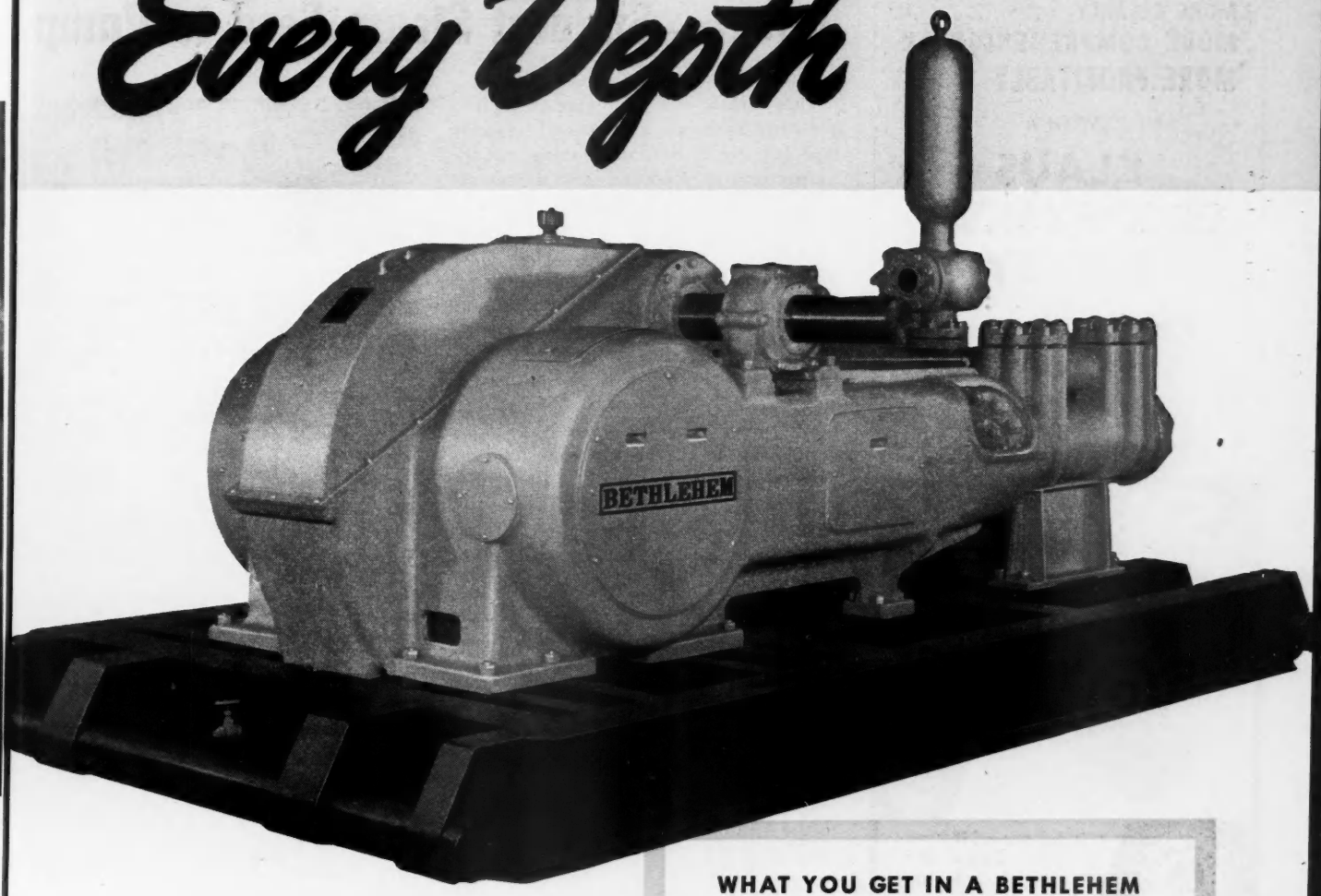

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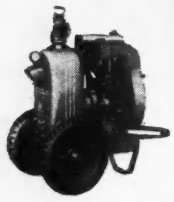
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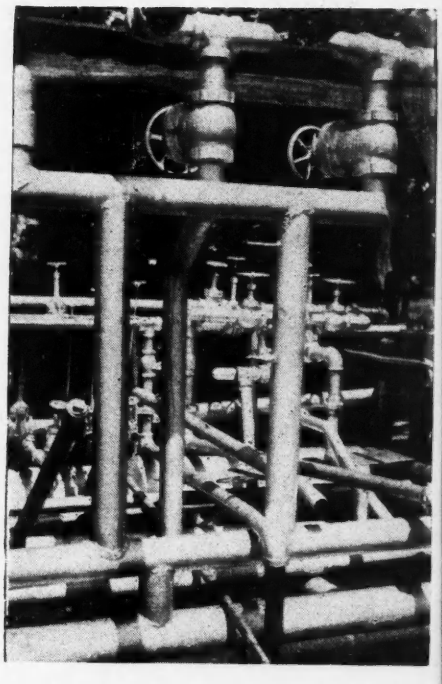
HOW TO—Support Steam Feed to Pump

This installation is unique in that it not only provides a support for steam lines leading to the mud pumps, but the connections used permit some movement of lines without breaking the joint. This type of steam feed to the mud pumps requires an overhead line about eight feet above ground, thereby removing a stumbling hazard near the pumps, and at the same time these hot lines are removed from possible contact.

The parallel lines at the bottom handle steam. The top line is the live steam line leading from the boiler battery, while the lower line carries exhaust steam from the mud pumps back to the boilers to be used for stack blowing. These two lines have been joined together by short risers spaced about 12 feet apart, and the dual lines thus formed are sectionalized for ease in erection.

Two risers of four-inch pipe were welded vertically to the live steam line, connecting to a short horizontal manifold about six feet above ground. Connections were provided for two supply leads, one of which is shown blanked off with a bull plug. The other is fitted with a valve, a tee and a union for ease in connection to the steam line to the mud pump. The

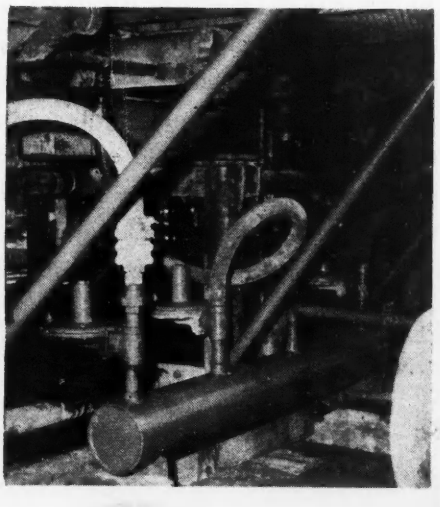


vertical risers support the entire piping, and the right-angle bend at the overhead runner allows for expansion in the line without placing undue stress in the pipe connections.

HOW TO—Simplify Engine Fuel Hookup

Drilling engines that operate on gaseous fuel, either natural gas or butane, can be connected to the fuel supply simply and easily by the method illustrated. The application of rubber hose to carry gas from the volume tank to the carburetor regulator has eliminated the use of many pipe connections. The slight difference in setting up the engines on each location makes it difficult to obtain a perfect fit with such piping. The constant vibration of the engines tends to loosen unions and connections.

The installation shown is flexible and is easily connected to the engines from below the substructure. The hose absorbs any vibration so that it is not transmitted to the connections on the regulators or volume tank. A unitized volume tank has four outlets, three of which are equipped with pressure regulators, and the fourth for incoming fuel supply. Unions on each of these lines make it easy and quick to install this system, and it is flexible enough to preclude exact setting. The volume tank acts to balance out any sudden demands on fuel, and makes it necessary for only one fuel line to be connected to the rig.



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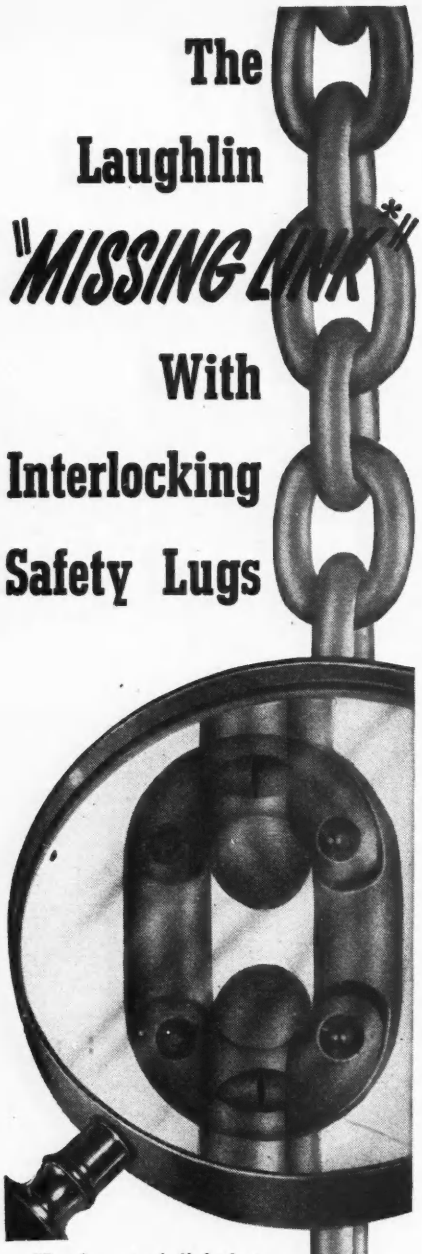

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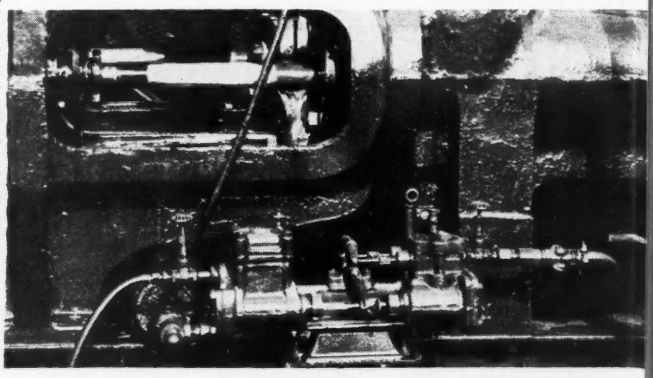
HOW TO—Adapt Pump for Lubrication



A small 3 x 2 x 3 steam reciprocating pump has been adapted by a Gulf Coast drilling contractor to provide continuous lubrication of the piston rods on both heavy-duty power driven mud pumps. In the case of steam rigs, a plentiful supply of steam would be available for this service. In this case, however, compressed air was used for several purposes around the rig, and was used as a source of power to drive the small pump.

The pump was mounted on an extension plate welded to the mud pump skid frame. Compressed air was piped to the pump through a flexible rubber hose that can be seen at the right of the pump. The air exhausts through a short riser equipped with an ell to stop entry of rain and dirt.

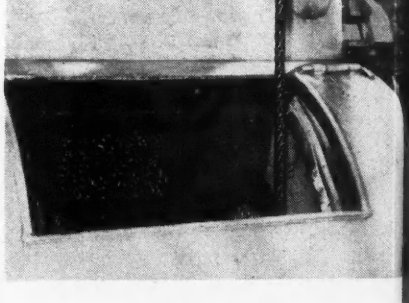
The pump discharges lubricating oil through a neoprene rubber hose attached to a valve at the left of the pump. The hose feeds oil to one-fourth-inch copper tubing that has been permanently mounted on the pump so that the flow of oil is over the rods near the packing glands at the fluid end. The flow of o can be seen dripping from the rods jus under the hose lying over the mud pum frame.

Oil is collected in a section of four inch pipe bolted across the pump ski frame and extends beneath the expose section of piston rods on both cylinders A 1¼-inch pipe connects this oil supp with the suction of the small pump. Th lubricating oil flows over the rods an back into the oil supply tank made fro four-inch pipe. The pump picks it u again and discharges the oil over th rods to provide a continuous supply o lubrication oil on the rods to increas their life and efficiency of the pump.

HOW TO—Protect Brake Bands in Rain

Since the opening to the drawworks drum is exposed to the weather just as the open floor area of the rig is exposed, it is not uncommon for the brake drums and brake bands to get wet during a hard rain. The presence of water on the braking equipment is not desired even though at shallow depths the effect is negligible. However, on heavy loads, wetting of the brake bands and drum can cause trouble in braking.

A remedy for this situation was provided on one rig as shown. A simple protective covering was placed over the exposed parts of the brake band and drum to shelter these parts from the rain. The covering was a narrow piece of galvanized roofing material that was formed to fit the circular brake band. It was bolted to the brake band and extended over it slightly. Any water falling in the drum opening that would othe wise wet the brakes would be deflecte to the bottom of the drum compartme and onto the derrick floor. Very litt time and effort was required to pla this inexpensive covering in place, a it has provided smooth, all-weath braking.



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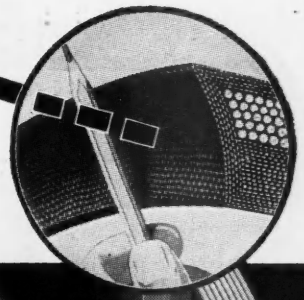
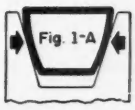


Pick up *any* V-belt having the ordinary straight sides and *bend* the belt. Three things will happen, right before your eyes.

(1) The top of the belt is under tension and grows *narrower.* (2) The body, under compression, becomes wider. (3) The sides of the belt *bulge out.* (Figures 1 and 1-A, below.)

Straight-Sided V-Belt



How Straight-Sided V-Belt Bulges in Sheave-Groove

This bulging of the straight-sided V-belt in its sheave-groove costs you money in *two* ways—(1) The bulge causes uneven sidewall wear—*shorter life!* (2) The bulging side cannot evenly grip the wall of the sheave groove—a loss in *transmission efficiency!*

In figures 2 and 2-A, you see how the precisely engineered *concave* side of the Gates Vulco Rope exactly corrects this bulging.

Gates Vulco Rope with Concave Side.

No Side Bulge. Precise Fit in Sheave-Groove.

Two distinct *savings* result. (1) The Gates Vulco Rope wears evenly—*longer life!* (2) The entire side-wall grips the pulley—carries heavier loads and *sudden load increases* without slippage:—saves *belts* and also *saves power!*

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The Concave Side is *MORE IMPORTANT NOW* Than Ever Before

Because the sides of a V-Belt are what actually drive the pulley, it is clear that any increased load on the belt means a heavier load that must be transmitted to the pulley directly through the belt's sidewalls.

Now that Gates *SPECIALIZED* Research has made available to you SUPER Vulco Ropes—carrying fully 40% higher horsepower ratings—the life-prolonging Concave Side is naturally more important in conserving belt life today than ever before.

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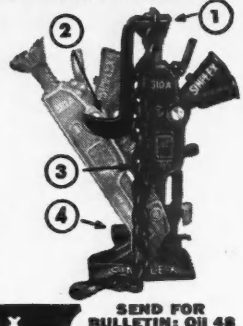

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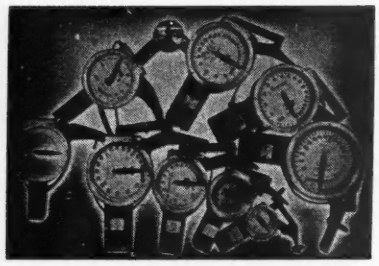

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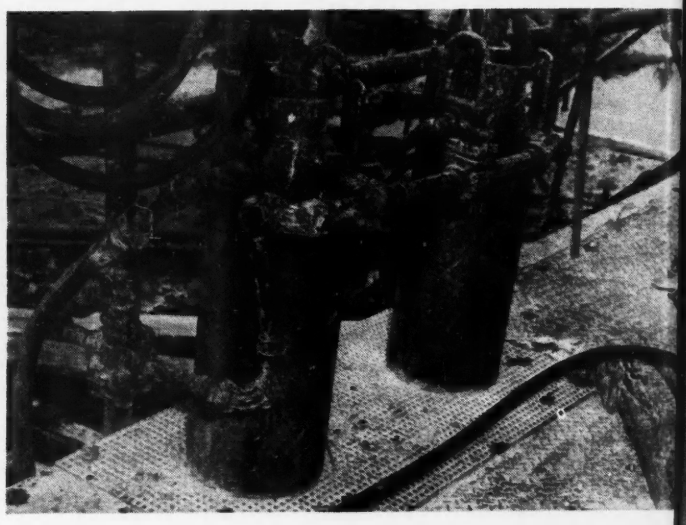
HOW TO—Add Preventer Control Valve



Plug-type, four-way valves are used on many rigs to control the blowout preventers. It is up to the operator just how these control valves should be mounted. The designers of one medium - depth power rig fabricated the device illustrated to support two plug-type four-way valves.

The control valve assembly is a simple one, and it places the valve stems at a convenient height for quick and easy operation. Sturdy construction of the supports facilitate closing and opening the valve.

Both valve supports were made from discarded 9⅝-inch casing, each section about 30 inches long. Bottom of each section of casing was welded to a foot plate which can be bolted to the derrick floor. Four slots are cut in the upper end of the casing to accept the valves as shown. To firmly anchor the valves in their support, a short cross piece is welded over the connection on opposite sides of the valve. This hold-down ca be seen on the line attached to the hos leading to the blowout preventer. Bai were added, one to each unit, so th complete assembly could be handle with the catline.

The device is flexible, providing co trol for either one or two blowout pr venters. The fluid pressure line is show at bottom left equipped with heavy-du valve. Flexible steel joints connect th pressure line to the nearest contr valve. A tee and block valve connect th pressure line to the second control valv

HOW TO—Speed Connecting Rig Hoses

The modern power rig is equipped with many remote control and indicating instruments which necessitate a maze of hoses and pipes. These lines are for pneumatic controls of clutches, throttle for lubricating pressure and temperatu indicating instruments, and many othe In the modern power rig, unitizatio

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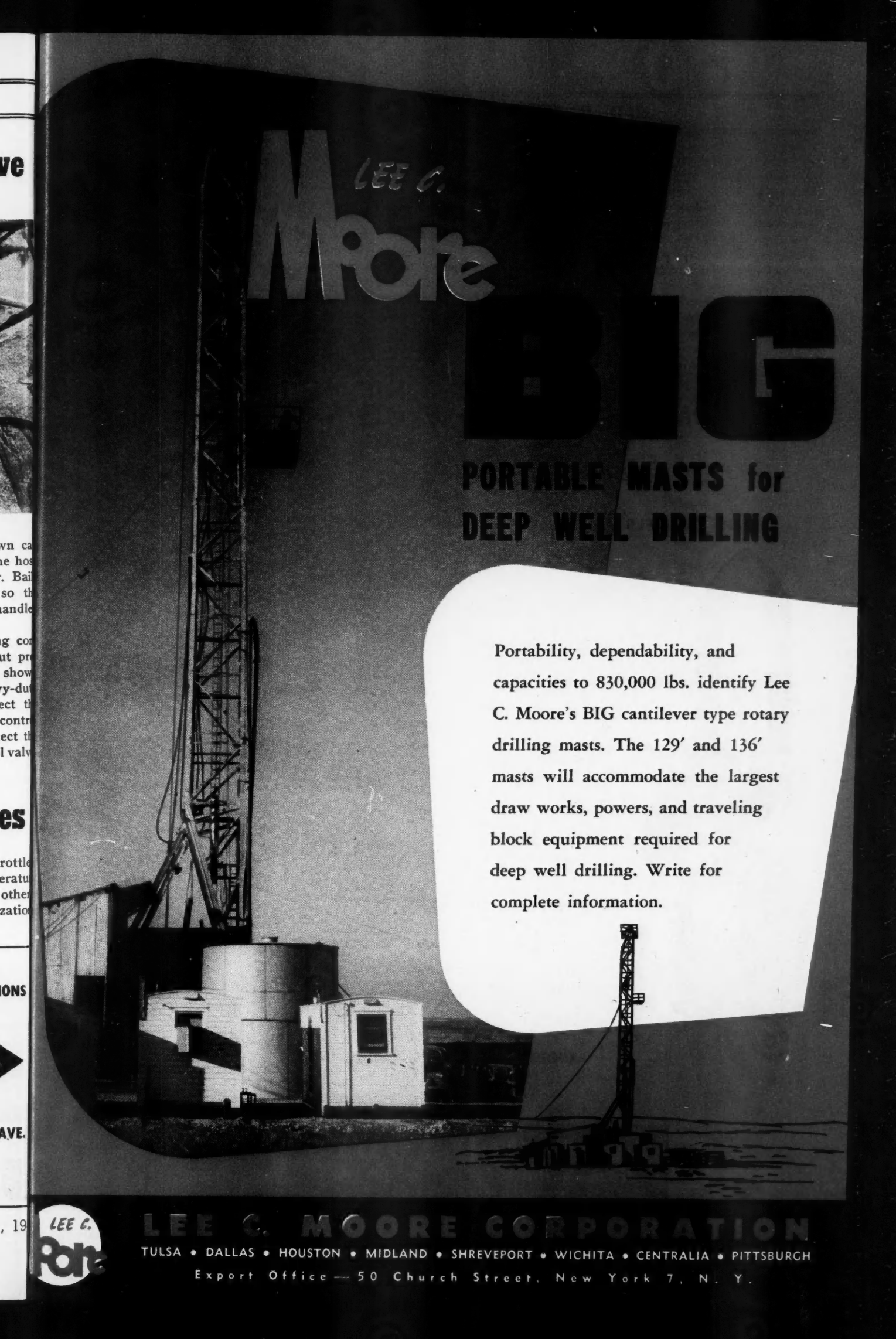
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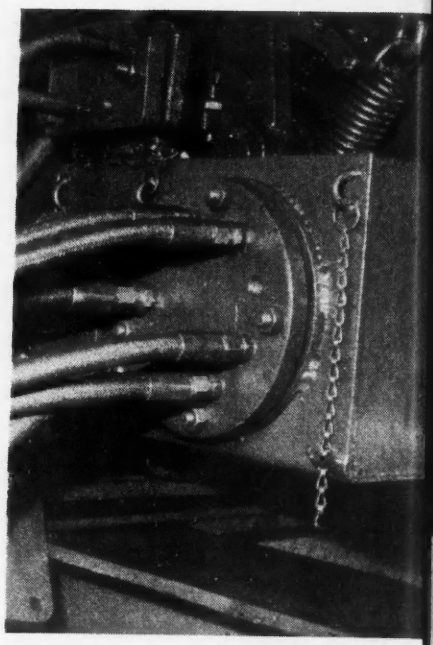
of component parts have facilitated tearing down, rigging up and moving. The separation of the controls from the prime movers makes it necessary to string this maze of pipes and pressure lines from the engines up to the drawworks. Upon tearing down the rig, each line had to be individually disconnected and plugged.

Considerable time has been saved in moving the rig and setting it up, as well as reduced wear of the connections through the installation of a connector box, which serves a purpose similar to the multi-pronged plugs used in the electrical field. The receptacle has been well protected by a heavy steel case welded to the engine substructure. All lines from the power plant and clutches terminate at this receptacle. A circular face plate equipped with machine unions fits over the receptacle as shown and is bolted in place until all connections are tight. The flexible hoses are attached to this face plate and continue up to the drawworks control panel.

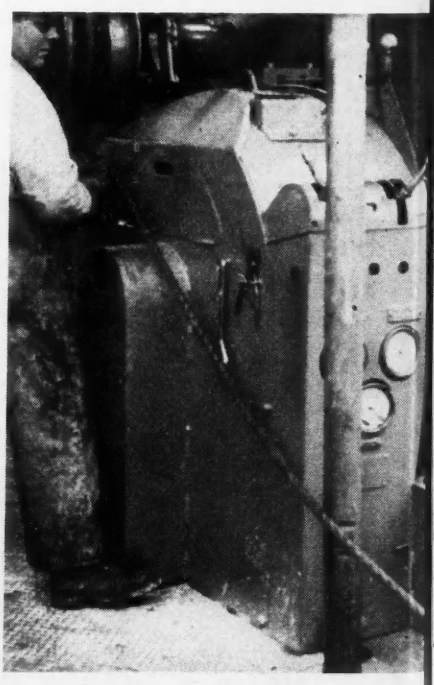
This device makes it necessary for only four bolts to be removed in order



that six lines be disconnected. This system can be used for all types of pressure or vacuum lines that interconnect various parts of the rig.

HOW TO—
Add Foot Throttle

Complete speed control of the engines can be had for cathead operations when an auxiliary throttle is installed below the cathead. If the controls are grouped on a console near the position the driller occupies when making hole, the engines must be speeded up for using the catline



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2. Drilling water wells.
3. Core Drilling and Geophysical Drilling.
4. For slim hole drilling.
5. Working over oil wells.
6. Washing down pipe and tubing.
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Types 32-GA, 53-GA and 20-GW swivels are alike in general design, but vary somewhat in detail.

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There are no other swivels which are comparable on a basis of capacity in proportion to weight.

Their high capacity in relation to their lightness make them ideal for use in remote and inaccessible places.

The 53-GA is used for drilling medium depth oil wells; also used extensively on work-over rigs. It is an ideal swivel for slim hole drilling.

The 32-GA is used with large water well rigs and for drilling relatively shallow oil wells. It is also used with long strings of tubing for washing down and similar operations.

The 20-GW swivel is used for drilling shallow and medium depth wells. The 20-GW is the smaller of the three and is used on water wells, core drilling rigs and the heavier types of Geophysical Rigs. It is also suitable for handling tubing in the shallower oil fields.

All materials used in King Swivels are the best and most suitable for their purpose. Lubrication is provided and all connections are to API specifications or to the order of the customer.

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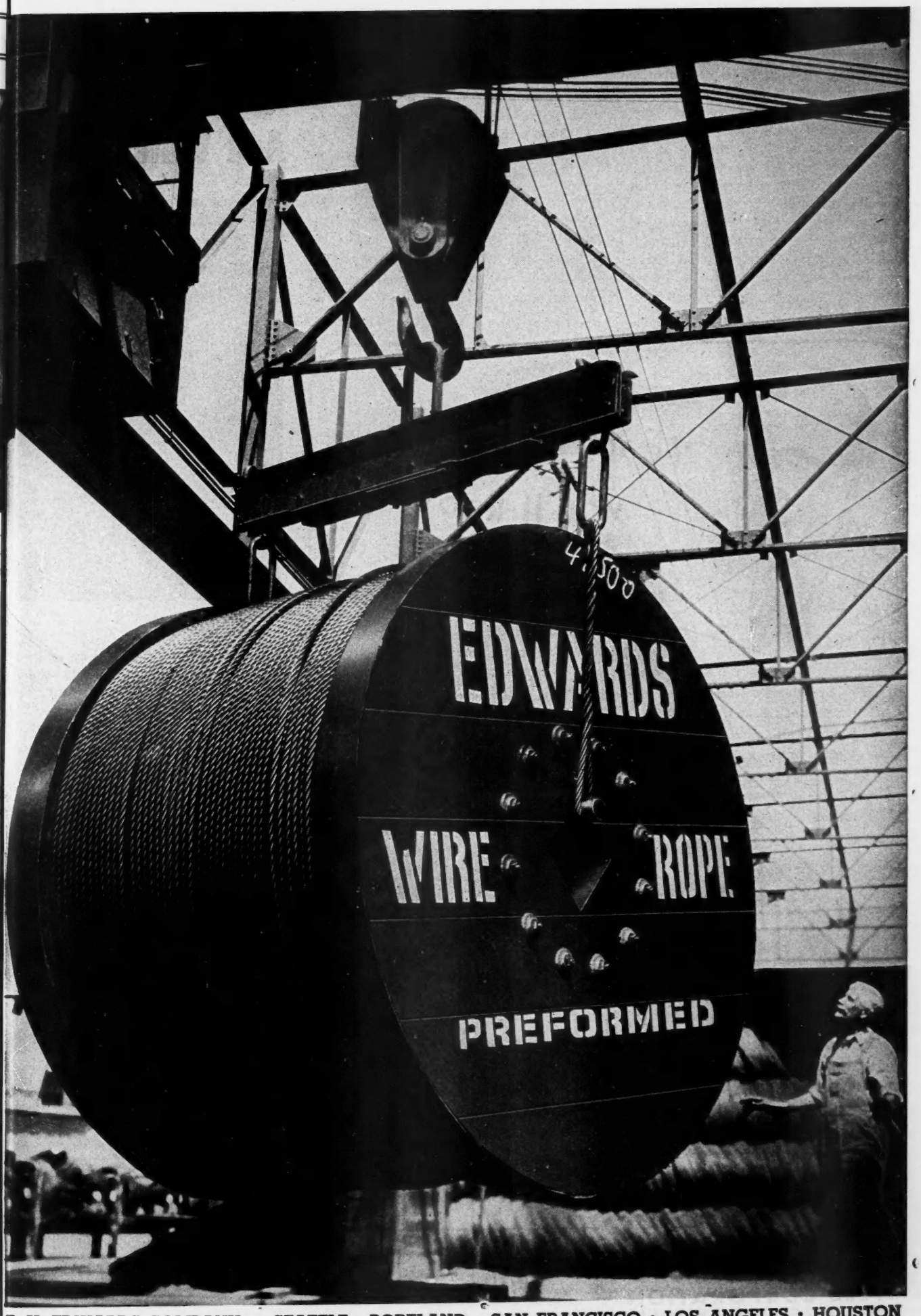

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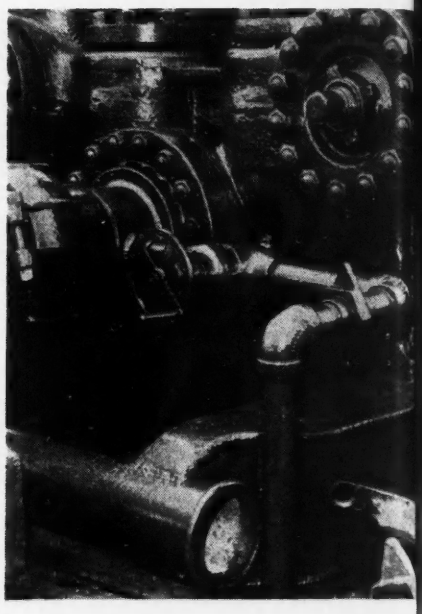
and the speed reduced after the driller leaves the position at the cathead when the joint has been made up.

It has been found that time is saved by locating an auxiliary throttle at floor level convenient for use with the right foot so that the speed can be controlled through the time necessary to use the catline. The foot throttle is connected with the hand throttle by means of cables, springs for return, and toggles for directional control of the throttle rigging.

The throttle itself is simply a vertical rod, or pin, having a large round head which rises two or three inches above the floor at the convenient location. By the use of this auxiliary foot throttle, the man at the cathead can easily control the power and the speed of the cathead to suit varying conditions, and instantly cut the power by simply removing foot pressure, instead of having to walk several steps to the hand control on the console.

HOW TO—
Add Water Supply



The varied operations that must be performed during the drilling and completion of an oil well make it useful and time saving to have high-pressure fresh water available for pumping down the drill pipe. Such operations as washing out the hole or placing a fresh water cushion in the drill pipe for a drill stem test, and many other jobs, require fresh water in the hole.

Rig designers of one large power rig incorporated provisions for furnishing water through the standby mud pump, thereby making available high-pressures for the water if needed. This is a precautionary measure in some cases where smaller pumps put up sufficient pressure to handle the job at hand, but did not offer the factor of safety that could be provided by the larger standby pump.

The manner in which this is accomplished is illustrated. A 2½-inch connection has been tapped into the mud pump suction line on the flanged nipple section, which is joined to the flexible suction hose by a union. This smaller line is connected to the fresh water system of the rig and is equipped with a gate valve and other unions for ease in setting up.

When it is desired to supply fresh water at high pressures with the standby pump, the union in the suction line is uncoupled, and the union blank is inserted and tightened. The water line is then opened to supply the pump suction with fresh water.

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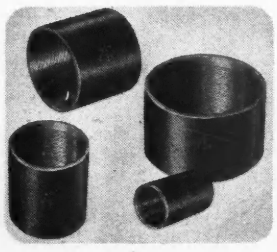

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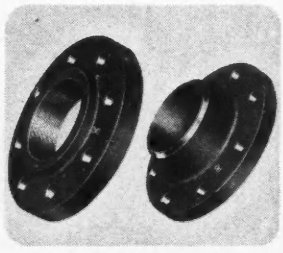

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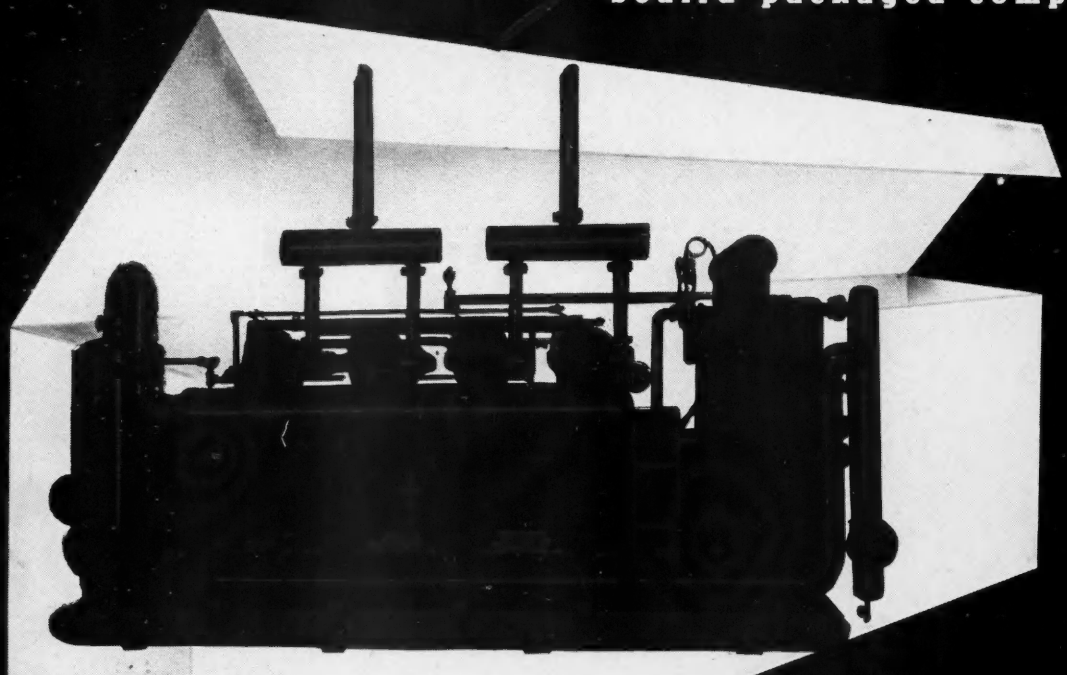

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Aerial view of the Cedar Point tank battery. At extreme right may be seen the shore station of Humble Oil & Refining Company, operator of the Red Fish Reef field. Pipe line right-of-way in the background leads to a tank farm at Oak Point where the oil is barged out.

Standard Oil Company of Texas' Marine Operations in Galveston Bay

By J. E. KASTROP
Staff Writer

WHEN Standard Oil Company of Texas undertook its first venture in the Gulf Coast, it became a pioneer in marine operations in the first submerged oil field in Texas. Standard of Texas, in a joint project with Salt Dome Oil Corporation, brought in its first wildcat in Galveston Bay on February 12, 1938. This discovery well, the State 1, was located just one mile offshore from Cedar Point, after which the field was later named. Today, there are 36 producing wells in the field with total oil production, as of April 1, 1949, of 5 million barrels.

Discovery date of Texas' first underwater field followed by one month The Pure Oil Company's and The Superior Oil Company of California's discovery of the Creole field off Cameron Parish, Louisiana, first offshore well in the Gulf of Mexico.

Initial flow from the State 1 was 647 barrels daily through a one-fourth-inch choke from Frio sands at 6030 feet. State and public sentiment regarding pollution and drilling operations in Galveston Bay have changed little since that day, and the discovery well, just as others that followed, was fortified against all forms of pollution and blowouts. Under the watchful eye of V. G. Lund, then district superintendent for Standard of Texas, Loffland Brothers carried on a successful and careful drilling campaign with their best diesel-electric heavy duty rigs. The first rigs employed were mounted on piling while the power and auxiliary equipment were carried on floating barges. Extensive use was made of drip pans under all machinery. A 77-foot section of 24-inch casing was first driven into the bay bottom before drilling commenced in order to eliminate pollution. Development of the field proceeded cautiously, but steadily.

Little more than six years later, on June 14, 1944, Standard of Texas completed its State 1, Tract 109, for 250 barrels daily on one-eighth-inch choke from the Frio at 8130-55 feet. The field is about 1½ miles offshore from Smith Point, the name the field now bears. Continuing its exploratory campaign in Galveston Bay, an outpost well was drilled in Tract 201, approximately one mile northeast of the Red Fish Reef field. This well came in on October 31, 1946, with a potential of 288 barrels per day from the Frio at 8752-66 feet. It is the only well in the East Red Fish Reef field.

After more than 11 years of successful marine operations in Galveston Bay, drilling and production practices have been established that provide a vast backlog of information which has proved useful in the exploitation of other similar marine fields. In the light of intensified developments in the continental shelf of the Gulf Coast, a study of operations in the first submarine field in Texas should reveal some interesting and helpful practices.

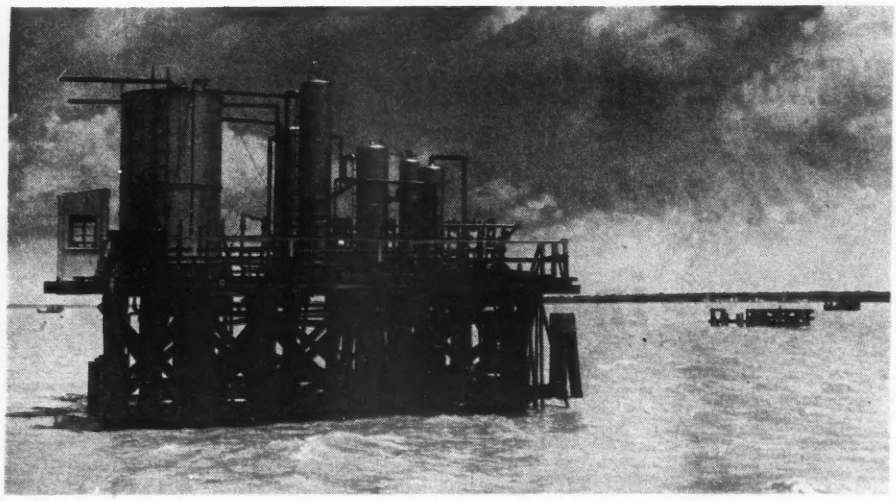
Production of oil from beneath navigable waters that also border on commercially-developed shores is no easy

WHEN STANDARD Oil Company of Texas and Salt Dome Oil Corporation discovered the first submerged oil field in Texas, they encountered problems for which there was no backlog of previous experience. In more than 11 years of successful operation in Galveston Bay, production practices have been established that offer enlightenment to those making similar ventures in marine or offshore waters.

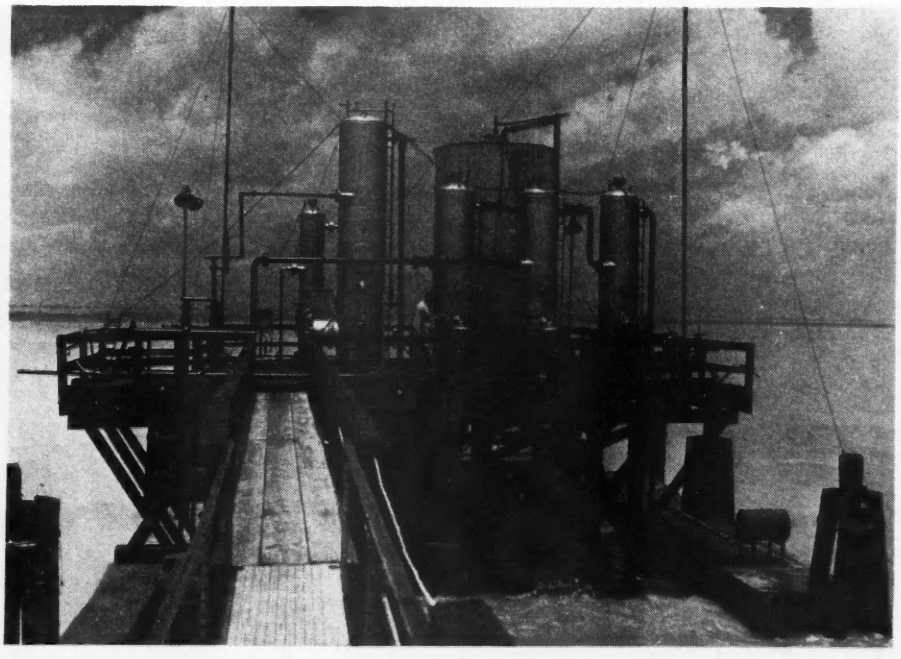
job. Not only is it difficult, but it is also costly. There are seemingly endless regulations, both state and federal, that must be followed in addition to statutes pertaining to onshore operations. Since these submerged lands belong to the State of Texas, the Commissioner of the General Land Office exercises authority in the State's behalf. From his office the land is leased. The Commissioner has promulgated rules and regulations governing drilling and producing operations in coastal waters. These regulations specify definite casing and cementing programs, blowout prevention, casing testing, well head equipment testing, swabbing, flow lines and tank batteries in the bay area. These rules are in addition to the authority vested in the Railroad Commission of Texas, from whom the permit to drill must be obtained, and which body closely governs completion and production practices.

After a permit has been granted by the Railroad Commission to drill the well, application must be made to the U. S. Army Engineers Corps for permission to erect a piling structure in Galveston Bay. The War Department granted a blanket permit for the bay area, with the stipulation that a detailed application be filed for each construction project.

The U. S. Coast Guard, having cognizance of navigational aids in all coastal waters, has specific rulings regarding the markings and lighting of well and separator structures that form a hazard to navigation in the bay. This normally includes a red light visible through 360 degrees of arc, operative from dusk to dawn. The bay area has long been a source of fish and oysters to the state, and therefore is under the supervision of the Texas Game, Fish and Oyster Commission, whose responsibility it is to prevent pollution that would damage marine life.



Separator platform in the Cedar Point field about one mile from the Cedar Point tank battery shown in distant background. Two wells at right flow into separators on platform. Stock tank is used to test production of wells.



Large separator platform in the Smith Point field. Fluids flow from this structure through a six-inch pipe line ten miles in length to the Cedar Point tank battery. C. R. Reglin, district superintendent, is inspecting the separator battery.

Cedar Point Field

Eight different producing horizons have been developed in the Cedar Point field since its discovery in 1938. In the Miocene section there are six producing zones from 3050 feet to 4400 feet, producing oil ranging in gravity from 25 to 27 degrees API. The remaining producing horizons are in the Frio from 5922 feet to 6018 feet flowing 37-gravity oil. There are 36 producing wells in three state tracts (94, 119, and 118) which comprise the present productive limits of the field. Daily production from the field is about 2000 barrels of oil.

Tract 94 contains two producing wells, one flowing from the Frio and the second on gas-lift from the Miocene. These wells produce clean oil of about 36-gravity. Production flows directly to the Cedar Point tank battery through two 2½-inch lines. This lease averages about 200 barrels daily.

In Tract 118 are 26 producing wells, five on gas-lift. Three additional wells have been shut in due to excessive water production. Two producing wells flow directly through one 2½-inch line to the Cedar Point tank battery where the gas is separated to furnish the shore station gas for treating and other purposes. Two 4-inch lines handle production from the separator batteries to the shore battery where the fluids are treated and the water removed. Daily oil production from Tract 118 is about 1600 barrels.

Five wells produce in Tract 119, one on gas-lift. There is one dead well on the lease, and one well has been shut in. Production is carried from the separator battery in the field to the shore station through two 2½-inch lines. Average production of the lease is slightly over 300 barrels of oil daily.

Smith Point Field

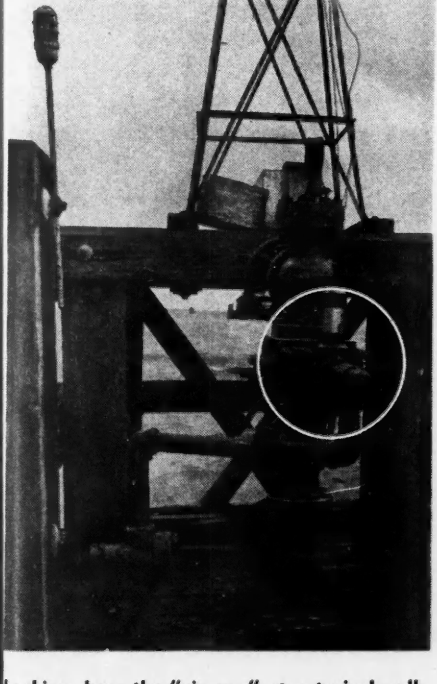
This field is located 1½ miles offshore from Smith Point in Galveston Bay in State Tracts 109 and 110. Exploration was by reflection seismograph as early as 1929. The field was discovered by Standard of Texas' State 1 (Tract 109) which was completed June 14, 1944, with a potential of 250 barrels of oil daily through a one-eighth-inch choke. Pro-

duction is from the Frio at 8130-55 feet. The structure is a faulted domal uplift with the productive structural closure lying on the upthrow side of the strike fault. There are now two productive horizons in the field, both of which are in the Frio: 8114-54 feet (Smith Point sand which produces 42-gravity oil), and 9442-58 feet (gas).

There are 12 producing wells in the field, five of which are on gas-lift. One of the 12 wells produces sufficient gas to lift oil from the five gas-lift wells. The field produces about 4300 barrels of fluid daily, 1900 barrels oil and 2400 barrels water. Cumulative production to April 1, 1949, was approximately 2,500,000 barrels of oil.

Fluids from this field flow to the Cedar Point shore station through a six-inch line about ten miles long. Discharge pressure on the separators at the field is maintained at about 150 pounds per square inch to carry the water and oil through the line. Pressure loss in the ten-mile line is about 100 pounds. Fluid reaches Cedar Point separators at 50 pounds per square inch.

East Red River Fish Reef field is one mile northeast of Red Fish Reef field and about five miles southeast of Smith Point field in Galveston Bay, State Tract 201. Exploration included subsurface geology from other bay wells and reflection seismograph. The discovery well, and only well to date, is Standard of Texas' State 1 (Tract 201) which was completed October 31, 1946. The well was brought in with a potential of 288 barrels oil daily from the Frio at 8752-66 feet. Total depth of the discovery well was 11,390 feet. Standard of Texas subsequently drilled one additional well which was dry and abandoned at 9583 feet. State 1 is the only well in the field now producing about 80 barrels of oil daily. Cumulative production as of April 1, 1949, was 53,000 barrels of oil. Production flows through a 2½-inch line to the separator platform at the Smith Point field, from which it joins the flow stream from the latter field through a six-inch pipe line to the Cedar Point tank battery.



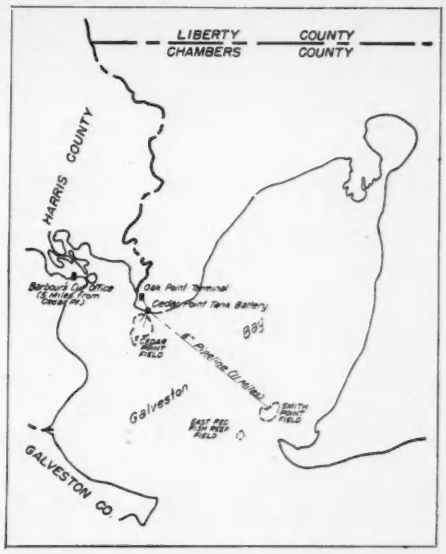
Looking down the "pig pen" at a typical wellhead installation on producing wells in Galveston Bay. Encircled is a storm valve used in addition to a bottom-hole storm choke. This valve closes automatically when pressure in the flow line drops abnormally due to a line break. Note lighting at left. Small derrick supports windmill generator which furnishes power for the light.

Production Practices

The problems of separating production from each State tract for bookkeeping purposes, and of separating oil requiring no treating from emulsified fluids, offer a challenge to the production engineer. Terminus of all fluid production from Standard of Texas' three fields (Cedar Point, Smith Point and East Red Fish Reef) is the tank battery on shore at Cedar Point. The battery is shown in the aerial view. About 4000 barrels of oil per day are treated and stored at this battery. Total storage capacity for oil at Cedar Point is 12,000 barrels. It is divided according to field and leases as follows: In the Cedar Point field, 1000 barrels for Tract 94, 4000 barrels for Tract 118 and 1000 barrels for Tract 119; and a total of 6000 barrels for the Smith Point and East Red Fish Reef fields, the production from which is combined.

Production from two wells producing clean oil from Tract 94 in the Cedar Point field flows directly into two 500-barrel tanks. From Tract 118 in this field, two wells flow directly to the shore battery through one 2½-inch line. These wells are relatively high-pressure and gas separated from the fluids is used as fuel for the heater treaters and for other station purposes. Two four-inch lines carry the remaining production from this lease to the treaters at Cedar Point. Fluids from one line flow directly to a heater to remove emulsified water and then to storage. The other line leads first to a free water knockout before connecting to another heater, and then to storage. Two 2½-inch lines carry production from Tract 119 to the Cedar Point tank battery. Fluids first enter a separator before going to a small heater treater to remove some water. Additional water is removed by a 750-barrel gun barrel tank before the oil flows into two 500-barrel storage tanks.

Of the 4300 barrels per day fluid produced from the Smith Point and East Red Fish Reef fields, 2400 barrels are salt water. This production flows from



Generalized map showing relation between fields, Cedar Point tank battery, and district field offices at Barbour's Cut.

the field to the Cedar Point tank battery through a six-inch line. Fluid flows through two separators hooked up in parallel, then through a free water knockout, after which it flows through a seven-inch header to three heaters also operating in parallel. Oil is then stored in three 2000-barrel tanks.

The Pasotex Pipe Line Company moves all this oil through a six-inch pipe line to Oak Point, about two miles away, where it flows into storage tanks awaiting delivery to nearby refineries by barge. The pipe line station pumps only during daylight hours which is sufficient at present to take care of all production from these fields. Three gas engine-driven rotary gear pumps are operated in parallel, requiring one station foreman gauger.

Separator Platform

Separator platforms were erected at strategic points in Cedar Point field and in the Smith Point field. These separator batteries perform two primary functions: (1) They eliminate stringing individual flow lines from each well to the shore station, and (2) they provide a means of periodically testing individual well production.

Illustrated is a typical separator platform made from creosoted piling. The main platform is about 14 feet above high water, heavily cross-braced and boarded over with two-inch creosoted planking. Flow lines from each well lead up to separator platforms and connect into a flow line manifold. From the manifold, the pumper can control the flow of fluid from each well, allowing it to flow through the lease separators or through the test separator. The Smith Point platform contains two separators to handle production from Smith Point and from East Red Fish Reef. A third

separator is used in series with the first two to insure complete separation of fluid from gas, which is now being flared. This practice prevents any condensate or oil from being discharged into the flare line. A large separator and 500-barrel stock tank are employed as a well test hookup. Each well is tested periodically to determine its performance. A fourth high-pressure separator is used at the Smith Point separator platform to knock out any liquids produced from the gas well furnishing gas for the five gas-lift wells in this field. All gas for lifting purposes is carefully metered.

Safety Features

Production practices from marine fields must necessarily include more precautions against pollution than in the case of similar fields on shore. Since everyone has access to the bay waters, additional safety measures must be taken to guard against broken flow lines occasioned by dragging anchors, wave action, corrosion, etc. Common practice for wells of this type is to place a storm choke in the bottom of the tubing to shut off the flow if there is an excessive pressure drop due to a line break. An additional measure is the installation of a storm valve on the flow wing of the Christmas tree. This valve is shown encircled in the photograph of a typical well head installation. This type valve also acts on a pressure differential, allowing a small steel ball to drop onto a seat to block the flow of fluid. The valve remains closed until the ball is manually removed from its seat after the back pressure on the flow line is returned to normal.

Precautions against overflowing the testing tanks on each separator platform were included to stop the flow of fluid into the testing system in case weather prevented the pumper from returning to the platform and diverting the flow stream back into the production separators. This system is unique and will be described in more detail in a future article. Dog houses are installed on each separator platform to afford protection to the pumper when he makes up his daily reports. The dog house on the Smith Point platform is separated from the main structure by a steel walkway. This section would prevent a fire from burning up the complete structure if lightning should fire it.

All equipment units on these open separator platforms are securely anchored by guy wires to protect them from being blown over in a hurricane. In 11 years of operation winds have not been of sufficient velocity to do any damage.

Production and Transportation Costs

Production costs to get oil from each well into the pipe line vary widely due to the amount of treating and servicing required for each well. In the case of oil produced from Tract 94 in the Cedar Point field, the production cost per barrel is relatively low. But in the high water-oil ratio wells producing on gas-lift in the Smith Point field, production costs are exceedingly high. Average production cost per barrel from marine fields is considered to be about 25 cents more than the average production cost per barrel from comparable fields on land in this area.

To adequately service and operate its Galveston Bay wells, Standard of Texas employs eight boats and three large steel service barges. Two of the eight boats are tugs, while the remaining six are personnel boats of varying size. One tug is on call at all times during drilling and workover operations, while the second tug is used only during an eight-hour day. Personnel boats are available at all times. Five of the personnel boats are company owned, and the other is rented on a contract basis.

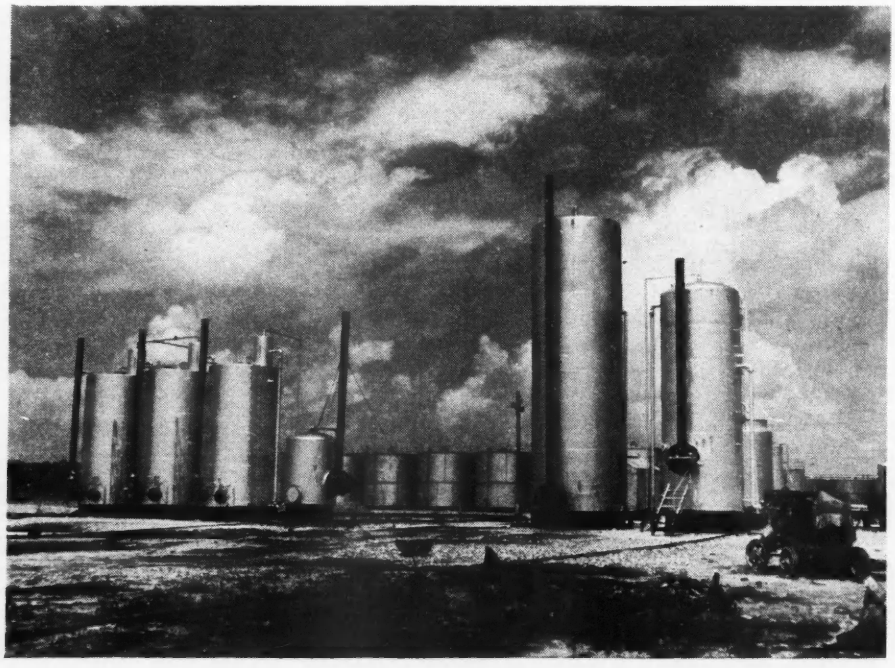
Transportation difficulties and the abnormal characteristics in producing marine oil fields require considerably more men than would normally be employed for a similar area on land. A total of 35 men is required to handle the production and maintenance of the company's wells in Galveston Bay. This group includes the following types of personnel:

District Foreman	1
Assistant Foreman	1
Petroleum Engineers	2
Clerks	3
Drilling Foreman	1
Mechanic	1
Assistant Mechanic	1
Gang Pushers	2
Relief Gang Pusher	1
Roustabouts	6
Boatmen	6
Pumpers and Gaugers	10
Total	35

Piling and platform construction in the Bay is done by contract, as well as is the job of laying flow lines under the water. The personnel list shown above includes only company-employed men.

A Job Well Done

That Standard of Texas has, for more than 11 years, developed and produced oil wells in Galveston Bay to the satisfaction of five or six regulatory bodies, and in the face of excessive costs, is a tribute to sound management and skilled engineering. Experience gained and production methods established should be a helpful guide in the development of other marine and offshore fields.



Battery of emulsion treaters at the Cedar Point station. Considering total production, an estimated 50 percent salt water is handled and separated from the Cedar Point and Smith Point fields. Storage tanks are in background.

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Field and Laboratory Tests of

Sodium Chromates and Alkalies

for Controlling Corrosion in Gas Condensate Wells

Part 1

THE PROBLEM AND A RESUME OF RESULTS OBTAINED

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U. S. BUREAU OF MINES,
BARTLESVILLE, OKLAHOMA

THE Bureau of Mines began its investigation of the use of chromates for controlling corrosion in gas-condensate wells in 1944, and since then, the results of field and laboratory tests have indicated that these compounds are effective and economical inhibitors. Rates of corrosion in the flowstring now can be reduced to negligible values by maintaining low concentrations of the inhibitor in the water phase of the flowing fluid. The chromates are not equally serviceable in all wells and fields, and the principal problem of their use is one of preventing chemical reduction to insoluble hydrous chromic oxide which may be deposited on the walls of the tubing and obstruct flow. Maintaining a high pH in the flowstream by injecting alkalies with the chromates and avoiding high concentrations of the cromates in the flowstream are effective methods of minimizing the reduction of chromates by substances that occur in some reservoir fluids. Costs of chemical treatment in two gas-condensate fields indicated that corrosion protection by means of sodium chromates and alkalies adds less than $1 to the expense of producing a million cubic feet of gas.

Although sodium or potassium chromate as the principal or sole ingredient of some corrosion-inhibiting materials had been in extensive use in other industries for many years, little was known before 1944 concerning the effective use of these compounds for preventing corrosion in gas wells. Accordingly, laboratory tests were made to determine whether sodium chromate would inhibit corrosion of steel by aqueous solutions of carbon dioxide, by the fatty acids, and by phenol because these substances are believed to be causes of corrosion in gas-condensate wells. The favorable results obtained in the laboratory led to tests at wells in the Opelika (East Texas) and Cotton Valley (Northeast Louisiana) fields, and this report, completed February, 1949, is a continuation of a report[1] published in 1946 in which the early experimental results obtained in the laboratory and field were presented.

Chromates now are being used in several gas-condensate fields of the Gulf Coast area. Sodium dichromate has been used extensively by The Texas Company for control of corrosion in wells in the Erath (South Louisiana) field since July, 1945. In April, 1948, Waldrip[2] presented the results of a survey made to determine the extent to which corrosion was being combated by chemicals injected into the flowstream of gas-condensate wells. Replies to a questionnaire sent by him to 23 operating companies concerned 1334 wells, of which 130 were being successfully treated with chemicals. Neutralizers (ammonia, soda ash, sodium bicarbonate, and like materials) were being used in 53 wells. Organic inhibitors were being used in 28 and chromates in 49 of the wells. The survey indicated that the number of wells scheduled to receive chemical treatment was soon to be increased to 232, of which approximately 30 percent would be treated with chromates or with chromates combined with alkalies.

The Cotton Valley field, where most of the Bureau of Mines tests were made, is one of the first gas-condensate fields in which the effects of corrosion on well equipment were observed. At one time 30 of the 76 producing wells were subject to various degrees of corrosive attack. Hock,[3] in a report on corrosion costs in the Cotton Valley field, estimated that the cost of repairing 13 wells that required work-over in a 3-year period averaged $3906 per well. The estimate did not include the cost of repairing damage to connecting lines and other surface equipment or the loss of use of wells under repair. Wells completed in the Bodcaw sand and subject to corrosion were estimated to produce an average of 4177 million cubic feet of gas between work-over jobs.

Summary of Bureau of Mines Test Results

It was determined early in the tests in the Cotton Valley field that the use of relatively inexpensive quantities of the chromates would reduce the rates of corrosion of well equipment to negligible values. Rates of corrosion of test cou-

pons installed in the well head could be reduced from 0.045 ipy (inches penetration per year) to 0.002 ipy, and at the same time the iron (Fe) contained in the effluent water could be reduced from 100 parts per million to 3 ppm by injecting 1.23 pounds of sodium chromate and 1.95 pounds of sodium hydroxide into the well to flow with each million cubic feet of gas produced. Such treatment of the well provided an excess of chromates in the effluent water, averaging 75 ppm, so that the yellow color of a water sample withdrawn at the well head afforded ready indication that the treatment was proceeding effectively and satisfactorily. Moreover, the flow capacity of the tubing was not changed by such treatment, and reaction products apparently were carried to the surface in the flow stream as rapidly as they were formed.

Determining Treatment Variance

The greater part of the experimental effort in the field was directed toward determining how much the treatments could be varied without loss of required benefits and what results would be obtained when values of important control factors were varied over wide ranges. As the flowing fluid, the well, and the operating conditions were not representative of all gas-condensate wells requiring protection against corrosion, controlling factors were varied to extremes, so that the information obtained would be applicable to as many wells and conditions of operation as possible.

The pH of the liquid water flowing through the tubing was found to be an important factor in controlling the conversion of soluble chromates to insoluble, reduced chromium compounds. Chromic acid injected into the flow stream caused the effluent water to have a pH of 5.1, and the equivalent of 2.66 pounds of sodium chromate per million cubic feet of flowing gas was reduced to deposit-forming, hydrous chromic oxide. The flow capacity of the tubing was lowered by this treatment. Sodium dichromate, sodium chromate, and sodium chromate plus sodium hydroxide each were injected in a series of tests to provide successively higher values of pH in the flow stream. The combination of sodium chromate and sodium hydroxide rendered the water in the flow stream the most alkaline; the pH of the effluent water averaged 7.7. In this alkaline treatment, only 1.20 pounds of sodium chromate per million cubic feet of gas were reduced to chromic oxide, and the flow capacity of the tubing was either maintained or increased as the deposits on the walls of the tubing resulting from former well treatments were removed by the flow stream.

It was found also that excessive concentrations of chromates in the flow stream were conducive to reduction of the inhibitor to insoluble, non-protective compounds. On the basis of the results of 12 tests with mixtures of sodium chromate and sodium hydroxide, the quantity of inhibitor consumed during the flow of a million cubic feet of gas was 1.33 pounds when the concentration of sodium chromate in the effluent water averaged 373 ppm and 1.20 pounds when the concentration of surplus inhibitor in the produced water averaged only 75 ppm.

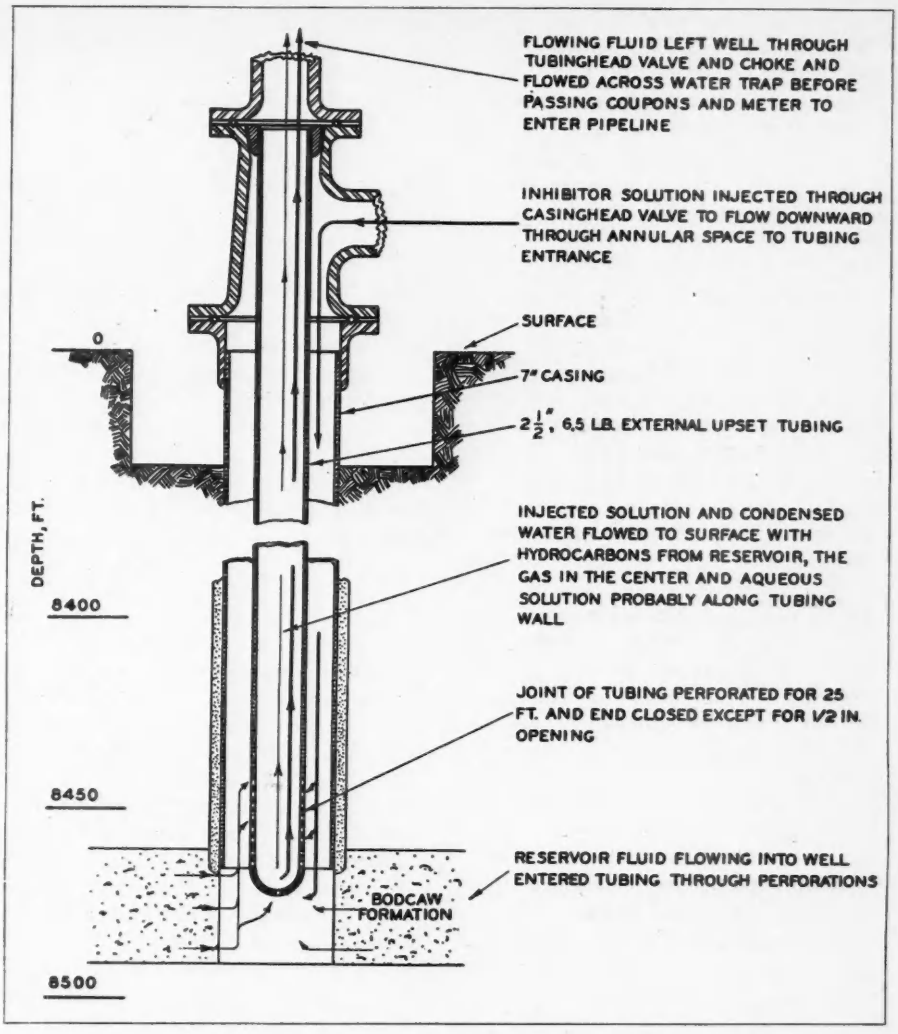
FLOWING FLUID LEFT WELL THROUGH TUBINGHEAD VALVE AND CHOKE AND FLOWED ACROSS WATER TRAP BEFORE PASSING COUPONS AND METER TO ENTER PIPELINE
INHIBITOR SOLUTION INJECTED THROUGH CASINGHEAD VALVE TO FLOW DOWNWARD THROUGH ANNULAR SPACE TO TUBING ENTRANCE
SURFACE
7" CASING
2½", 6.5 LB. EXTERNAL UPSET TUBING
INJECTED SOLUTION AND CONDENSED WATER FLOWED TO SURFACE WITH HYDROCARBONS FROM RESERVOIR, THE GAS IN THE CENTER AND AQUEOUS SOLUTION PROBABLY ALONG TUBING WALL
JOINT OF TUBING PERFORATED FOR 25 FT. AND END CLOSED EXCEPT FOR 1/2 IN. OPENING
RESERVOIR FLUID FLOWING INTO WELL ENTERED TUBING THROUGH PERFORATIONS
BODCAW FORMATION
DEPTH, FT.
0
8400
8450
8500

FIGURE 1. Schematic representation of equipment in test well.

Treatment Results

The treatments involving the lowest concentrations of sodium chromate in the flow stream maintained or increased the flow capacity of the tubing; excessive concentrations of the inhibitor, however, resulted in a lowering of its flow capacity. Similar results were obtained in five tests with sodium chromate as the sole treating agent. A concentration of 50 ppm of sodium chromate in the effluent water was enough for complete corrosion control throughout the entire length of the tubing and the christmas tree.

The results of these tests in which the rate of injecting inhibitor into the well was varied suggested that inhibitor concentrations in the flow stream could be further lowered and inhibitor conserved by diluting the flowing solvent phase with large volumes of injected water. Consequently, tests with both sodium chromate and sodium dichromate solutions were made in which six to 86 gallons of water were pumped into the annular space between the casing and tubing per million cubic feet of gas produced. Although this range of injection rates provided for increasing, by a factor of 6 or more, the volumetric rate of flow of water entering the tubing and, by a factor of 2, the volumetric rate of flow of water flowing through the christmas tree, results obtained did not show that advantage was gained by diluting the flow stream with water. It was estimated that in the absence of injected water a million cubic feet of gas entering the tubing was undersaturated to the extent of five gallons of water. For most of the field tests, a minimum of 20 gallons of water was injected into the well per million cubic feet of gas produced so

that liquid water would be available to carry the inhibitor through the bottom 400 or more feet of tubing.

The cost of using chromates for protecting wells against corrosion depends to a considerable extent on the cost of special equipment used in the treatments and on the extent of the precautions which are taken against such a hazard as possible loss of control of wells through failure of high-pressure equipment. Experience of operators in the Erath field with injecting sodium dichromate into wells indicates a total cost of $11.33 per day per well. Costs of similar operations in the Sheridan field of injecting a commercial inhibitor into wells average $7.87 per day per well. Injection operations in the two fields are similar in many respects; and if the cost of the extra string of casing used in wells in the Erath field is not considered, the average of injection costs for the two fields is $6.32 per day per well. Cost records in both fields are based on average production rates exceeding 6.3 million cubic feet of gas per day per well; and, on the basis of these records, corrosion protection by means of chromates adds less than $1 to the cost of producing a million cubic feet of gas.

Adapting Chromate Treatment to Individual Wells

On the basis of the information obtained over a period of 20 months during the testing of the well in the Cotton Valley field, the following procedure is recommended for adapting the chromate treatment to individual wells:

1. Before attempting to treat a well, determine the concentration of iron in the effluent water; and measure, by means of coupons exposed in the well head, the corrosiveness of the flowing fluid. Determine also the flow capacity of the tubing.

2. If the concentration of calcium and other alkaline earth metal salts in the effluent water from the well is low enough to permit the use of alkalies for increasing the pH of the water flowing in the tubing, inject into the casinghead to enter the flow stream at the tubing entrance a solution of sodium hydroxide, soda ash, or sodium bicarbonate at such a rate that the pH of the effluent water will be increased to approximately 7.7. The effluent water then may contain as much as 5000 ppm of the bicarbonate radical and perhaps an appreciable concentration of the carbonate radial.

3. Inject enough water with the alkali to saturate the flowing hydrocarbon fluid at the tubing entrance and provide an excess of liquid water for carrying the alkali in solution. A chart has been published (1, Figure 12) showing the relation between pressure, temperature, and the water-vapor capacity of lean, hydrocarbon fluids, that can be used to estimate the rate of injection of water necessary to saturate the flowing fluid.

4. Determine over a period of time, by means of weight loss of the exposed well head coupons and the concentration of iron in the effluent water, the corrosion control that is gained by increasing the pH of the effluent water. Determine, also, if there is any change in the flow capacity of the tubing.

5. Inject sodium chromate with the alkali in such concentration that the effluent water has a definite yellow color. A concentration of 50 ppm of a chromate is adequate and will provide a color that can be readily identified. If concentrations of the chromate much greater than 50 ppm are maintained in the effluent water, the consumption of sodium chromate may increase, in which event an accumulation of reduced chromium compounds in the tubing may result.

6. From the weight loss of well head coupons and the concentration of iron in the effluent water, obtain frequent measures of the corrosion control gained by injecting sodium chromates. Also periodically measure the flow capacity of the tubing.

7. In some wells in certain fields, the quantity of a chromate reduced to insoluble compounds in the flowstream is large enough to cause the formation of deposits of hydrous chromic oxide on the interior walls of the tubing. If the flow capacity of the tubing in such wells under treatment gradually decreases and the decrease is not due to deposits of alkaline-earth carbonates, diminish by small decrements over a period of weeks the weight of sodium chromate being injected per million cubic feet of gas produced; decreasing the weight of sodium chromate injected may result in a sacrifice of some corrosion control. As the concentration of sodium chromate in the effluent water diminishes below approximately 40 ppm, the protection afforded metal surfaces will be less and less effective, and the rate of corrosion will increase.

Test results obtained in the field and laboratory have shown that the rate of corrosion attained in the presence of traces of chromates differs only slightly from the rate of corrosion that would prevail in the absence of sodium chromate treatment. In adjusting the treatment for the well and the prevailing operating conditions, the weight of sodium chromate injected per million cubic feet of gas should be that which will give maximum possible corrosion protection and yet maintain the required flow capacity of the tubing. Coupons exposed in the well head will indicate if the christmas tree fittings and the upper lengths of tubing are not adequately protected by the modified treatment; concentration of iron in the effluent water will indicate the extent to which the entire flowstring is subject to corrosion.

Equipment Used in Treating Test Well

The test well in the Cotton Valley field is one of those producing gas-condensate fluid from the Bodcaw formation at a depth of 8460-90 feet. Figure 1 shows schematically the equipment in the well and the method of mixing the inhibitor solution with the fluid from the reservoir at the entrance of the tubing so that the full length of the inside of the tubing can be protected against the corrosive action of the flowing fluid. The lower ends of the tubing and casing, their positions with respect to the productive formation, and the perforations in the tubing are shown in true vertical scale. The illustration of surface fittings is entirely schematic and omits many details. The installation also includes 900 feet of 13⅜-inch and 590 feet of 9⅞-inch casing in addition to equipment shown in Figure 1.

Before the corrosion control test

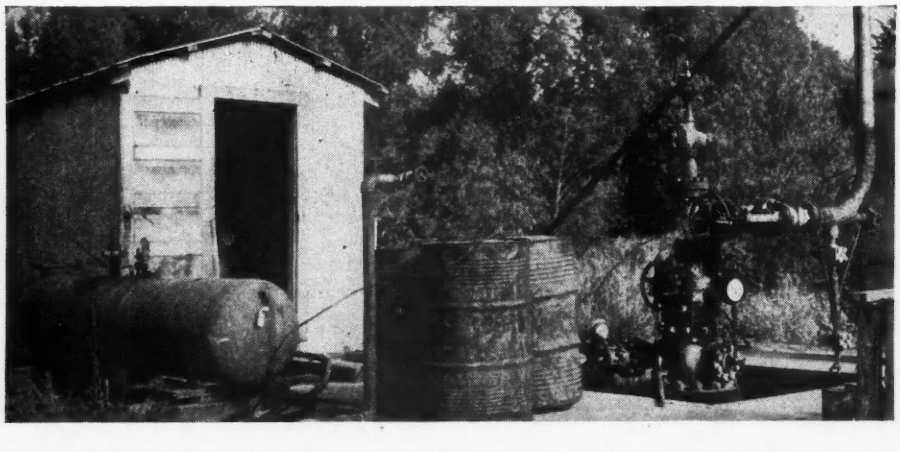

FIGURE 2. Surface equipment at test well in Cotton Valley, Louisiana field, including tank for storing chromate solutions under pressure.

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were begun in October, 1945, the tubing in the well and the fittings below the master gate were last inspected in September, 1943. The tubing had parted in the joint below the tubing hanger, and 1799 feet of tubing had been installed to replace that which had been affected by corrosion. Rate of corrosion in the well presumably did not change during the 24 months that elapsed between the time of this inspection of the tubing and the date on which the inhibitor injection tests were begun. A record of corrosion in the Cotton Valley field[2] shows that wells in the Bodcaw formation subject to corrosion produce an average of 4177 million cubic feet of gas at a rate of 4.93 million cubic feet per day before requiring inspection and work-over. On that basis, the test well would flow 28 months between work-overs and was within four months of another work-over when the injection tests were begun.

In November, 1946, while the injection tests were in progress, the tubing in the well was surveyed to a depth of 3000 feet by means of a tubing caliper. Very little corrosion of the inner walls of the tubing was indicated by the caliper survey, except in a single joint at approximately 2800 feet depth. In this joint a 0.13-inch deep pit was located near the base of a top upset. In June, 1947, after the injection tests had been completed, the well was "killed" by filling it with water and the tubing removed for thorough inspection. Threads in the tubinghead fittings indicated that some corrosion had taken place there, and a short nipple of tubing immediately below the tubinghead was damaged to the extent that it had to be replaced. The remainder of the tubing showed very little evidence of corrosion.

Surface Equipment

Figure 2 is a photograph of surface equipment at the well. Mechanical details of the christmas tree and connections shown include the trap downstream from the choke and a bolt-type coupling-covered opening in the flowline just beyond the trap through which a coupon was inserted for exposure in the flowstream. A second coupon was mounted in the flowline downstream from the first coupon at the opening in the vertical pipe where a sampling nozzle was installed when liquid:gas ratios of the hydrocarbon fluid were to be determined.

To expedite the tests requiring large quantities of water, the 217-gallon capacity propane storage tank shown in the lower left corner of the photograph was used to contain the treating solution under a pressure of approximately 60 pounds per square inch. Water for the solution was drawn from a tank near the well, and the solution was mixed in the barrels before it was transferred to the storage tank by means of a hand pump. The equipment for handling water was selected for special quantitative injection purposes rather than for routine service and permanence. Permanent equipment for general corrosion control, where large volumes of water must be injected into the well, could consist of a suitable high-pressure trap in the flowline from the well for collecting water continuously, and a pump for returning water to the casinghead from the trap.

The diaphragm-actuated injecting pumps used at the well during the first 12 months of the tests have been described in a previous report.[3] Pump valves for high-pressure service with interchangeable, precision-machined cones and seats were made especially for the tests. Improved models of such pumps with tanks, constructed for high-pressure service, now sell at $175 to $350, depending upon the pressure and volumetric capacity requirements. The gasoline-engine-driven pump installed for the tests that involved the injection of relatively large volumes of water is shown in Figure 3. Only the cylinder and piston of this pump were especially made; other parts were assembled from various sources at a total cost of approximately $250. By changing the drive pulley on the engine crankshaft and the speed of rotation of the engine, the capacity of the pump could be varied to inject from 50 to 300 gallons of solution into the well a day. These volumes of solution were pumped from the storage tank, where the pressure was 50 to 75 psi, into the casing against a pressure of 2150 psi. Gasoline rather than natural gas was burned in the engine to assure continuous operation of the pump while the tests were in progress.

The analysis of the water used in preparing the solutions that were injected into the well is given in Table 1. This water contained 35 ppm of calcium and 10 ppm of magnesium as compared with the 5 ppm of calcium and 1 ppm of magnesium in the water taken from the well when treating solutions were not being injected and an average of 5 ppm of calcium and 1 ppm of magnesium found in the effluent water when solutions were being injected. The calcium and magnesium in the treating water probably were precipitated in the barrels and in the storage tank when the alkaline treating solutions were mixed because analyses did not show significant amounts of these alkaline-earth elements in the solid material deposited on the wall of the tubing or in the water from the well.

TABLE 1

Water used in preparing solutions for injection into test well

Component in Solution	Formula	Concentration, Average, p.p.m.
Calcium	Ca	35
Magnesium	Mg	10
Sodium	Na	22
Iron	Fe	0
Carbonate radical	CO_3	0
Bicarbonate radical	HCO_3	174
Sulfate radical	SO_4	2
Chloride radical	Cl	23
Total solids by evaporation	....	188

Flow stream pressures were measured by means of a piston gauge mounted in the shelterhouse and connected through copper tubing to the tubinghead and casinghead. The rate of flow of fluid from the well was measured by an orifice meter equipped to record differential pressures in a flowstream containing a liquid phase. As all the fluid from the well flowed through a pipeline directly to the cycling plant, liquid:gas ratio measurements could not be made at the well except by occasional tests with portable equipment operated on less than 1.0 percent of the flowstream. Of the three phases flowing from the well (gas, liquid hydrocarbons, and liquid water) only the volume of the gas was measured continuously. The quantity of the liquid-water phase was of the greatest interest from the standpoint of corrosion control, but because it could not be measured, the quantity of water flowing with the fluid was estimated from pressures and temperatures in the reservoir and flowstring. As the volume of the water was directly proportional to the quantity of gas produced, all injection and recovery data were referred to a recovery of a million cubic feet of gas as a basis for comparison.

A substantial part of the data gathered in connection with the tests on the Cotton Valley field well was obtained in the field laboratory. Figure 4 shows most of the laboratory equipment used daily in analyzing water from the tubinghead of the well. The electric oven was used to evaporate samples of water when making total solids determinations; color disks and indicators were used for measuring the pH of the water, and the photelometer shown in the hands of the operator was used in determining the concentrations of iron and chromates in the effluent water. Procedures for making colorimetric tests for iron and chromates are described in a booklet of tentative methods assembled by the NGAA Corrosion Research Project Committee.[4] Other laboratory tests requiring special apparatus were made from time to time.

Composition and Phase State of Flowing Fluid

Knowledge of the phase state and composition of the fluid flowing in the

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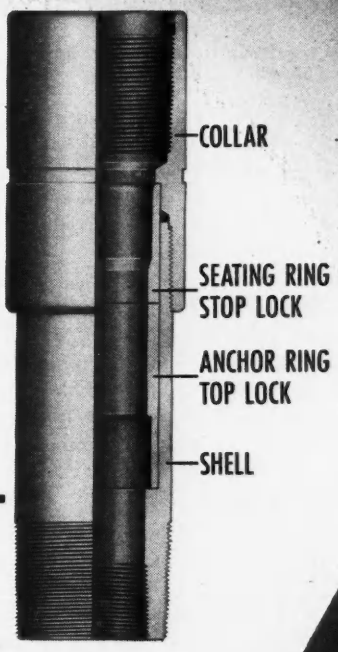

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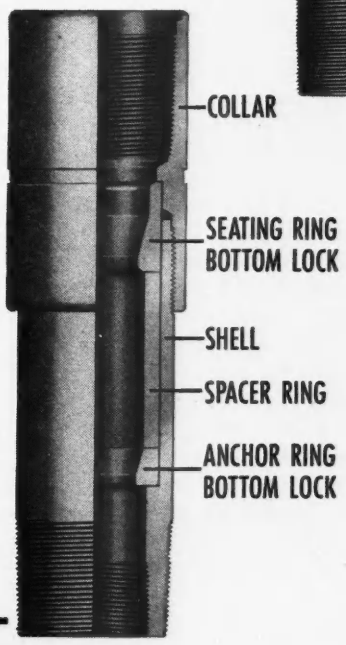

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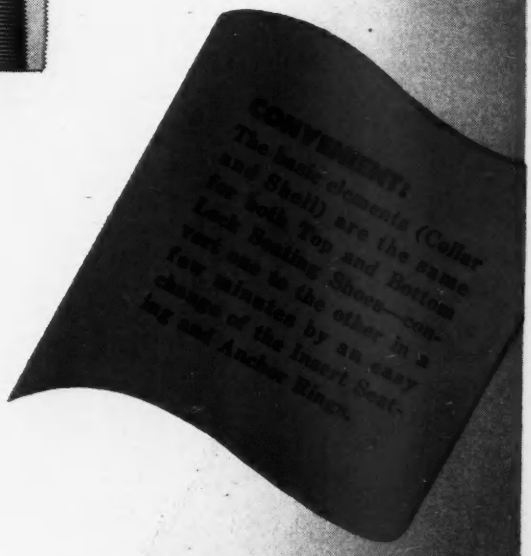
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FIGURE 3. Engine-driven pump for injecting treating solutions into casinghead of well.

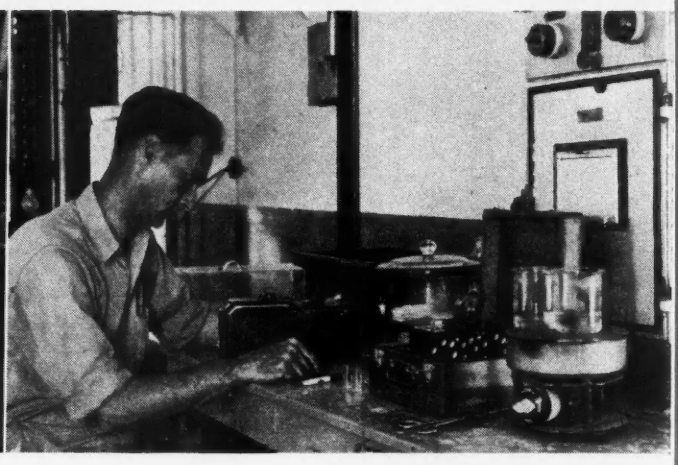

FIGURE 4. Laboratory equipment used in analyzing water and other samples from test well.

tubing of a well to be treated with an inhibitor is helpful in planning and applying effective treatments. Although the mobile, liquid:gas ratio-measuring equipment of the Bureau of Mines[5] was not used for determining the phase state of the fluid in the flowstring of the test well in the Cotton Valley field, estimates of the distribution of the liquid-water phase were made that are believed to be reliable.

Composition of Fluid

Table 2 shows the composition of the fluid from the test well based on analyses of fluid from the well and from other nearby wells producing from the same formation. Traces of hydrogen sulfide were detected in the fluid from some wells producing from the Bodcaw formation and the odor of this gas was distinguishable at the test well when atmospheric conditions were favorable. The carbon dioxide content of the fluid from the test well was determined several times by an absorption method. Relative quantities of the light hydrocarbons were determined by the low-temperature fractional distillation of the separator phases of fluid from a well adjacent to the test well. The hydrocarbon liquid: gas ratio shown in Table 2 was determined by the operators. The value given is the average of the determinations made at the test well in April, 1946, and in January, 1947, by means of portable equipment through which a portion of the flowstream was withdrawn for stage separation and measurement of the phases. Table 3 gives the results of a Bureau of Mines routine distillation of the hydrocarbon - liquid phase of the flowing fluid sampled when the first of the tests was made with the portable equipment. The method, commonly referred to as the Hempel method, was used in the analysis of this sample.

TABLE 2

Estimated composition of the flowing fluid

Component	Mole Percent
Hydrogen sulfide	trace
Nitrogen	1.0
Carbon dioxide	1.8
Methane	77.0
Ethane	8.7
Propane	4.6
Butanes plus	6.9
Total	100.0

Hydrocarbon liquid: Gas ratio at approximately atmospheric pressure and temperature, gal. liquid per 1,000 cu. ft. of gas.....1.90

Water liquid: Gas ratio at tubinghead (1,650 psia., 145° F.), gal. per 1,000 cu. ft. of gas...0.055

Table 4 gives the average analysis of five samples of water collected at the test well on different occasions and three weeks or more after the conclusion of a chromate injection treatment. Although the concentration of sodium, iron, and bicarbonates in the effluent water undoubtedly is affected for long periods after the injection of sodium chromates and alkalies into the flowstream has been discontinued, the averages for the other components shown in Table 4 are believed to represent reliably the analysis of the liquid water phase of the flowing fluid.

From the standpoint of treating the well with alkalies, it is of significance that the concentrations of calcium and magnesium in the well water were so low that there was little likelihood of the accumulation of a scale of alkaline-earth carbonates on the walls of the tubing.

It is of interest to consider the relation between the measured percentage of carbon dioxide in the gas (1.8) as shown in Table 2 and the measured weight of carbon dioxide per barrel of tubinghead water (0.36 pounds) at 1883 pounds per square inch absolute and 145° F. as shown in Table 4. It will be shown later in this report that pure water will dissolve carbon dioxide to the extent of 1598 ppm at a temperature of 145° F. and a partial pressure of $1883 \times 0.018 = 34$ psia. If the water were pure a barrel of the solution, therefore, would contain $0.001{,}598 \times 350 = 0.56$ pounds of carbon dioxide as compared with the datum 0.36 pounds per barrel given in Table 4. The mass of carbon dioxide dissolved in the well head water was 64 percent of the mass of carbon dioxide that would theoretically dissolve in pure water. Corresponding percentage comparisons on water samples from three wells in other fields where the well equipment is not subject to corrosion were only 6, 8, and 17 percent of the theoretical absorptive capacity of pure water. It may be that the capacity of a well water to absorb carbon dioxide determines whether or not it is corrosive.

Water in Flowstring

Estimates indicated that liquid water accumulated in the flowstring entirely as a result of condensation, the first drop of water appearing after the gas had entered the tubing and had moved toward the surface for a distance of several hundred feet. The 101 ppm of solids shown by Table 4 to be contained in

TABLE 3

Distillation analysis of hydrocarbon liquid phase in equilibrium with flowing fluid at approximately atmospheric pressure and temperature

Temp., °F.	Volume Fraction Distilled		API, 60 °F.
	Percent	SumPercent	
84	Initial	0.0	....
122	11.4	11.4	92.0
167	12.7	24.1	81.6
212	15.9	40.0	69.5
257	14.8	54.8	61.5
302	11.7	66.5	56.4
347	8.4	74.9	54.0
392	5.7	80.6	51.8
437	4.7	85.3	49.5
482	3.6	88.9	47.2
527	2.5	91.4	44.9
Residuum	3.4	94.8	40.4
Distillation loss	5.2	100.0	....

Sulfur, percent, less than 0.1.
Gravity of liquid sample, 65.6° API.

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the water must, therefore, have been carried from the formation into the tubing as a dustlike material in suspension in the flowing gas and, while in the tubing, was scrubbed from the gas by the accumulating liquid water. An idea of the dust-carrying capacity of gas can be gained from the fact that a million cubic feet of air in the ordinary factory or workroom contains 0.029 to 0.57 pounds of dust (6, p. 174) or enough to provide a concentration of 62 to 1240 ppm if dissolved in 55 gallons of water. (As indicated in Table 2, 55 gallons of water were estimated to have condensed at the tubinghead pressure and temperature of the test well from each million cubic feet of gas flowing.)

The chart presented in a former Bureau of Mines publication (1, fig. 12) which shows the water content of water-saturated natural gas as a function of pressure and temperature was used in computing the liquid:gas ratios of water in the flow stream of the test well. The temperature of the Bodcaw formation was 238° F., and the average formation pressure during the 20 months that the tests were in progress was estimated to be 2850 psia. Although reservoir pressure had declined considerably from the original pressure, it was assumed that formation water evaporated into the hydrocarbon fluid in place so that the fluid was continuously saturated. For the average reservoir pressure, the water (vapor) content of the fluid containing a million cubic feet of gas was 70 gallons, according to the water content chart.

At an average tubinghead pressure and temperature of 1650 psia. and 145° F., respectively, the water (vapor) content of the fluid was 15 gallons per million cubic feet of gas, indicating that 70 — 15 = 55 gallons of water were in the liquid phase. For computing the volume of liquid water passing the tubinghead per million cubic feet of gas, the volume of water injected into the casing of the well in the time required for a million cubic feet of gas to pass the tubinghead was added to 55 to obtain the water liquid:gas ratio in gallons per million cubic feet of gas.

By calculating the pressure on the gas entering the well from the sand face and following a similar procedure with the water-content chart, it was estimated that gas entering the tubing had a water-vapor capacity of 75 gallons of water per million cubic feet of gas. As the gas expanded in flowing from the formation into the area immediately about the well bore, an additional five gallons of water (75-70) could be evaporated from the sand for a time; but, as soon as formation water was removed from the sand immediately about the well, the gas entering the well bore was undersaturated to the extent of five gallons per million cubic feet of gas. It was estimated that the flowing fluid moved up the tubing more than 400 feet before the gas cooled enough so that its water vapor capacity again became 70 gallons per million cubic feet of gas. At such point in the tubing, the first drops of water condensed, and liquid:gas ratios of water above that point increased progressively to the tubinghead.

On the basis of these estimates, at least five gallons of water per million cubic feet of gas had to be injected into the casinghead to flow through the annular space to the bottom of the well and saturate the gas entering the tubing. The number of gallons of injected water available to flow upward through the lowest length of tubing and carry dissolved treating compounds was, therefore, five gallons less than the volume of solution injected during the flow of a million cubic feet of gas.

Not enough information was available to warrant a conclusion concerning the phase state of the hydrocarbon mixture as it entered the tubing.

TABLE 4

Analysis of water taken from well when treating solutions were not being injected; average over period of 20 months

Component in Solution	Formula	Concentration, Average, ppm
Calcium	Ca	5
Magnesium	Mg	1
Sodium	Na	22
Iron	Fe	49
Carbonate radical	CO_3	0
Bicarbonate radical	HCO_3	63
Sulfate radical	SO_4	5
Chloride radical	Cl	4
Total solids by evaporation	....	101
Organic acid radical as acetate	....	51[1]
Carbon dioxide in solution at 1,883 psia., 145° F.	....	1,028[2]

Note: Average pH at atmospheric pressure was 6.1.

[1] Analytical result obtained by titration method through the courtesy of P. L. Menaul, Stanolind Oil & Gas Co., Tulsa, Okla.

[2] This concentration is equivalent to 0.36 lb. per bbl. of water. The carbon dioxide constituted 19.9 mole percent of all the gas dissolved in the water under wellhead pressure and temperature.

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Stanolind Develops Short Courses for Engineers

Stanolind Oil and Gas Company has developed a series of short courses in technical subjects for its young engineers. Through this educational program, the company is keeping its technically-trained men abreast of new developments in the field of oil production.

Several such courses have recently been given by the company including those in drilling mud technology and in reservoir engineering. Courses in various other phases of oil-producing operations are under consideration.

The "mud school" was attended by ten young engineers, all of whom have had field experience in producing operations. They spent two weeks at the Stanolind general office and research laboratories in Tulsa, studying typical problems and accepted practices under the guidance of experienced lecturers. Recognized authorities from drilling mud service companies teamed with Stanolind mud experts to give the school a "faculty" of top-notch engineers with a broad background of practical experience.

The engineers brought to the conference room problems they themselves had encountered in the field. They heard lectures covering these problems, asked questions about them, and discussed them among themselves. The lectures were illustrated with lantern slides, and the discussion periods were supplemented by demonstrations and laboratory experiments.

Following the two weeks in Tulsa, the trainees were sent back to the field for six weeks of additional study. During these six weeks, they observed the uses of drilling mud at wells and studied it under actual field operating conditions.

During one of the two weeks in Tulsa, the engineers also studied well completion methods. Again, recognized experts were in charge of the work.

Stanolind engineering and research executives have found that many engineers are needed to solve the varied technical problems facing an oil-producing company. These include men who have studied mechanical, chemical and electrical engineering, as well as those who specialized in petroleum production. But college students often feel that their opportunities in the petroleum industry are limited if they have not had petroleum engineering training. So the company has established its educational program—of which the short courses are an important part—to bridge the gap which seems to exist.

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Application of Certain Instrumental Methods in Production Research

By
T. W. DENNIS and J. M. HUNT
The Carter Oil Company

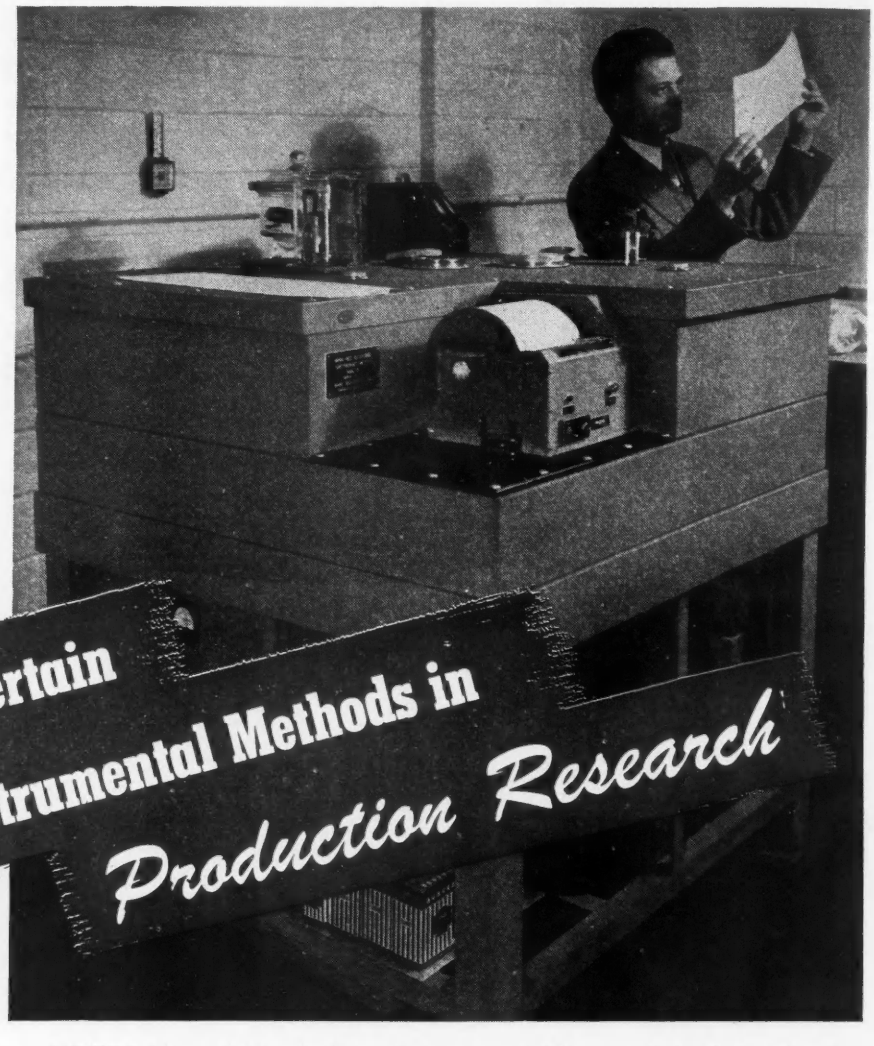

FIGURE 1. Oils, asphalts and other carbonaceous materials are studied with the infrared spectrophotometer.

THREE MORE or less well-known physical methods of analysis are being used in research on oil deposits and sedimentary rocks at the Carter Research Laboratory: the infrared spectrophotometer; the X-ray diffraction apparatus; and the differential thermal analyzer. The application of these instruments to petroleum production research is relatively new and of some general interest. The authors describe briefly the principles of each method and the type of study to which it is suited.

CRUDE oils, asphalts, and other naturally occurring hydrocarbons consist of complex mixtures of thousands of different compounds. As a result their accurate analysis is very difficult. It has been possible in the past to classify them on the basis of such physical properties as boiling points, specific gravity, refractive index, viscosity, and molecular weight. A valuable additional tool for their investigation is the infrared spectrophotometer.

Nearly all organic substances absorb infrared radiation of specific wave lengths. This absorption occurs when the frequency of the infrared radiation coincides with the frequency of vibration of the atoms within the molecules of the substance. The amount of radiation absorbed and the wave length of the radiation absorbed vary according to the size of the atoms, their binding forces, and their positions in the molecule. Consequently, each individual substance has a characteristic infrared absorption spectrum. The spectrum is unique for any one substance and changes as soon as another material is added. It may be compared to a set of fingerprints. Just as each individual has a set of fingerprints that will identify him, so each substance has an infrared spectrum that identifies it.

There are a number of techniques for determining the infrared spectrum of a substance. A recent paper by Williams[1] covers techniques and instrumentation in the entire infrared field.

An instrument that measures and plots the amount of infrared radiation absorbed by a substance is called an infrared recording spectrophotometer. Recording spectrophotometers are commercially available in this country from several manufacturers. One type of instrument, shown in Figure 1, utilizes a heated rod of silicon carbide as a source of infrared radiation. Radiation from this source is focused on the sample being studied, and part of the radiation is absorbed by the sample. The transmitted radiation is directed to a 60 degree prism which breaks it up into a spectrum of wave lengths. Radiation of one wave length is then focused on a vacuum thermocouple that measures the quantity of energy transmitted at that wave length. By means of a suitable amplifying and recording system, this energy is utilized to drive a pen which plots the amount of radiation transmitted by the sample. By coupling the rotation of the prism to the recording

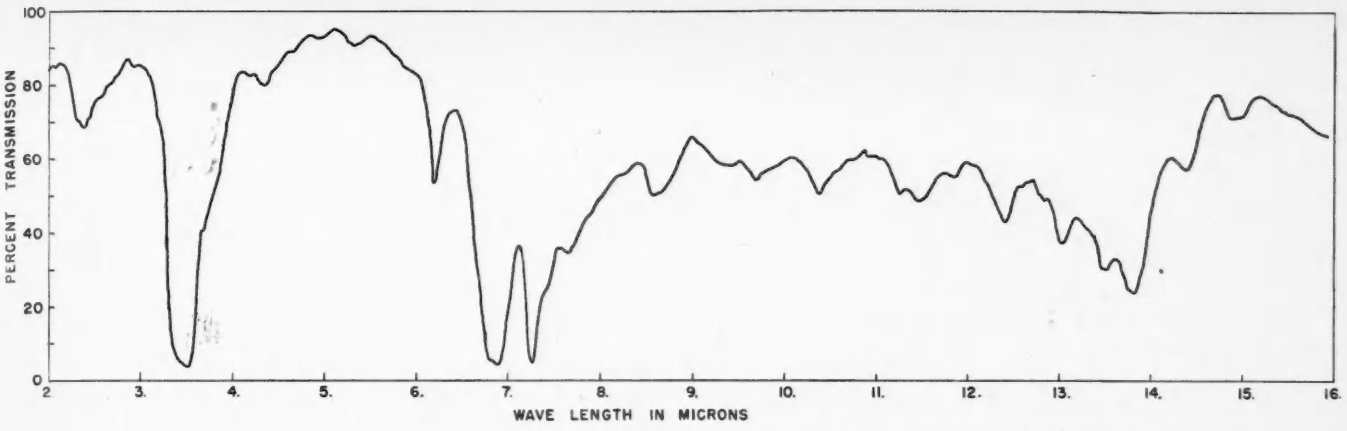

FIGURE 2. Infrared spectrogram of crude oil.

drum it is possible to obtain a continuous plot or spectrogram of the amount of radiation transmitted throughout the infrared range of wave lengths.

A spectrogram of a typical crude is shown in Figure 2. This oil absorbs infrared radiation most strongly at wave lengths of 3.5, 6.9, and 7.3 microns. It shows less absorption at wave lengths of 3.0, 4.1 and 6.4 microns. Absorption at wave lengths shorter than 7.5 microns is generally due to vibrations between pairs of atoms. The absorption at 3.5 microns is due to the carbon to hydrogen bond. At longer wave lengths groups of atoms cause infrared absorption. The absorption at 12.3 microns is generally attributed to the presence of aromatic groups, while that at 13.9 microns is attributed to long chain paraffinic groups.

Studies of Gases and Solids

Infrared studies can be carried out on gases and solids in thin sheets as well as on liquids. Solids can also be suspended as a fine powder in comparatively inert liquids, or they can be dissolved and examined in solutions. A bibliography covering many of the most recent applications in the field of infrared has been published by Barnes.[2]

Infrared spectrophotometry has a great advantage over conventional methods of anlysis in that it is possible to make a spectrogram with as little as 1 cubic centimeter of sample. As little as 0.1 cc. of sample can be analyzed with some research instruments. Another advantage is its applicability to the characterization of substances such as asphalts and the carbonaceous matter of shales in their natural state. These materials are generally altered by distillation or solvent extraction techniques.

In oil production research, the infrared spectrophotometer is being used to study natural crudes, waxes, and asphalts, and the carbonaceous matter in sediments.

Differential Thermal Analysis

Differential thermal analysis is used primarily in distinguishing clay minerals and other minerals that undergo reactions which absorb or liberate heat when their temperature is raised. These thermal reactions occur at different temperatures in different substances, so that the temperatures at which the reactions occur characterize the substance being studied. The substance to be tested is placed in a small hole in a metal block, and an inert material, such as aluminum oxide, which undergoes no thermal reaction on heating, is placed in another hole a fraction of an inch away. As the temperature of the block is increased gradually, usually to an end point of 1200° C., the temperature of the unknown and of the reference remain the same, unless some chemical reaction

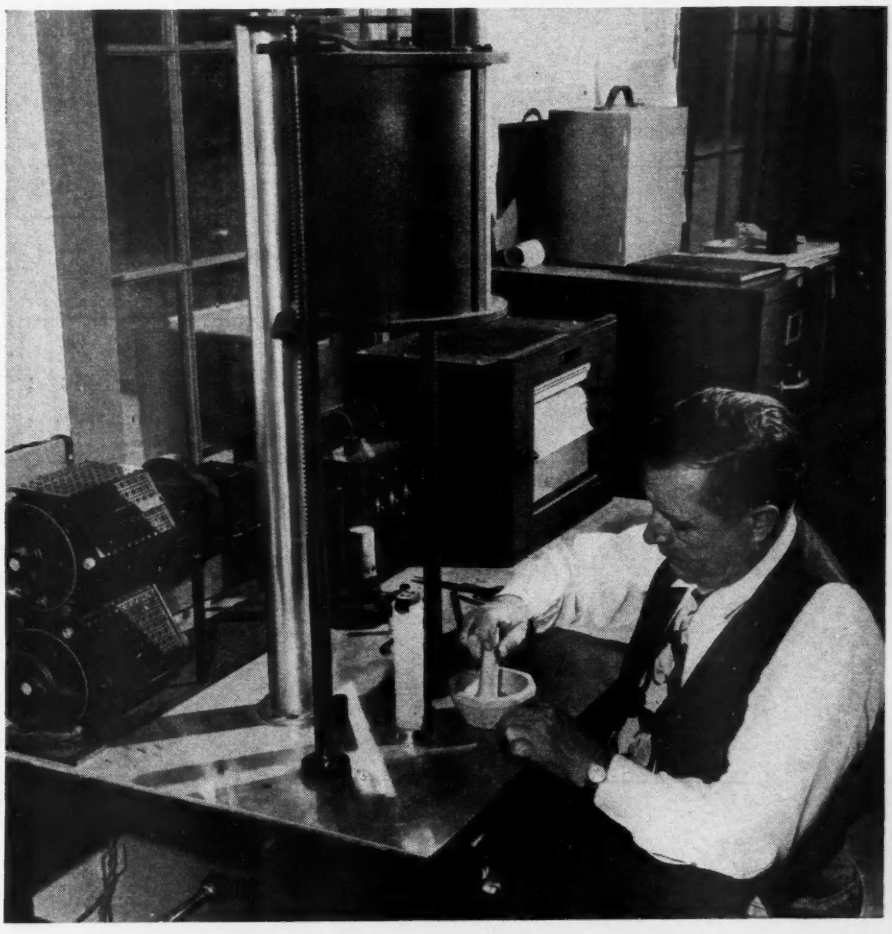

FIGURE 3. Further understanding of the nature of clays is gained from their behavior under differential thermal analysis.

takes place. However, if decomposition, dehydration or some types of re-crystallization occur in the unknown, heat is absorbed, lowering the temperature of the sample with respect to the reference. This is known as an endothermic reaction. Conversely, oxidation and certain types of re-crystallization cause the liberation of heat, raising the temperature of the sample relative to the reference. This is known as an exothermic reaction. The difference in temperature between the reference and the unknown is measured. The absolute temperature of the block at which these reactions occur is characteristic of the sample being analyzed.

The instrument shown in Figure 3 consists of a furnace, sample holder, and a temperature measuring and recording apparatus. The furnace is usually a well insulated, hollow core, resistance type. The voltage applied to the furnace is controlled so that approximately a linear heating rate is achieved. Several methods of controlling the heating rate can be used, such as auto-transformers that raise the line voltage steadily with time, or more elaborate program controlling devices. The sample holder consists of a block of nickel or stainless steel which has holes drilled in it to receive the samples. Nickel is used because of its high melting temperature, excellent thermal conductivity, and relative low cost. Stainless steel has slightly less conductivity and oxidizes more rapidly. Appropriate thermocouple junctions are centered in the sample holes.

The temperature is measured by means of a thermocouple circuit which alternately measures furnace temperature and differential temperature as shown in Figure 4. A recording potentiometer is the most usual means of recording the temperatures, although a mirror galvanometer-photographic system has been used.[3] Recently, multiple analysis, in which two or more samples are analyzed simultaneously, has been developed.[4] The Carter Oil Company apparatus measures three samples at once.

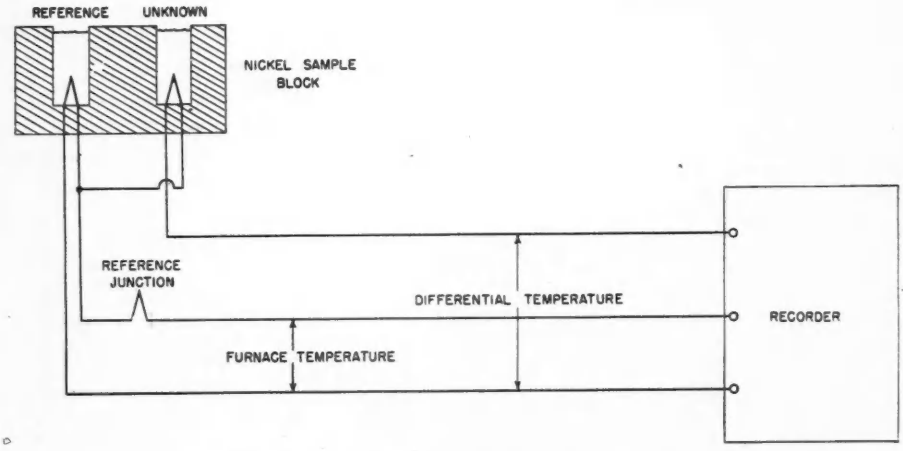

FIGURE 4. Schematic thermocouple circuit diagram.

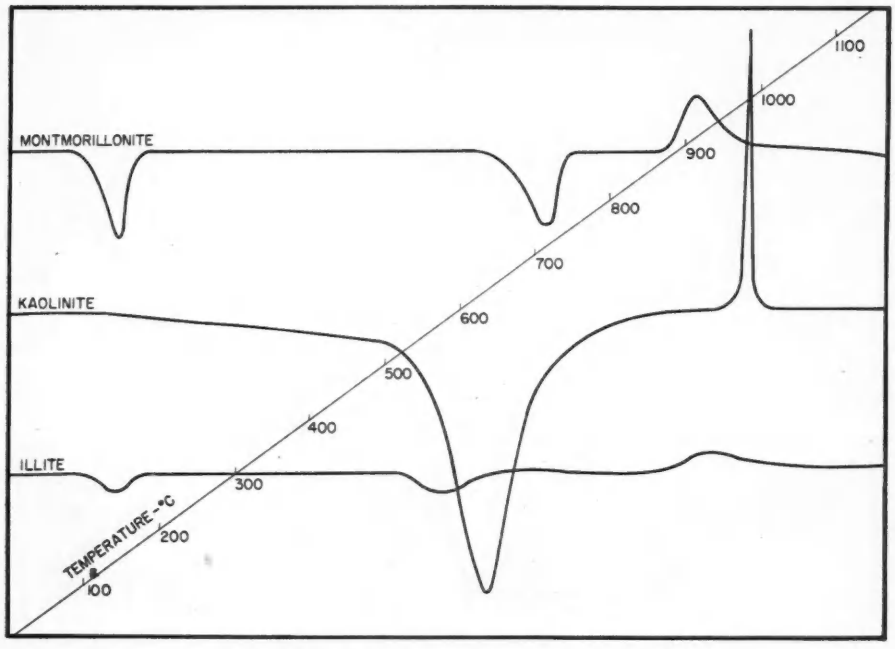

FIGURE 5. Differential thermal curves of clay minerals.

Typical Clay Minerals

Figure 5 shows the curves of three typical clay-minerals. The furnace temperature curve runs diagonally across the page. The top differential curve is for the clay mineral, montmorillonite. The initial endothermic reaction is caused by the loss of adsorbed water which starts at 100° C. The second endothermic reaction is due to the loss of the water of crystallization at about 700° C. An exothermic reaction occurs at about 950° C. which is due to the crystallization of the gamma crystal form of aluminum oxide from amorphous alumina. The second curve is that of kaolinite. It will be noted that there is no adsorbed water given off, as kaolinite is not a swelling-type clay mineral. The large endothermic peak at 620° C. is due to the loss of the water of crystallization. Kaolinite has four times the amount of water per unit cell as montmorillonite. The sharp exothermic peak at 980° is the crystallization of amorphous alumina to gamma aluminum oxide. Kaolinite has twice as much aluminum per cell unit as montmorillonite. The lower curve is typical of illite, a hydromica. The loss of some adsorbed water is noted at 100°-200° C. The loss of crystal water takes place at about 550° C. and there is a slight re-crystallization that takes place at about 900° C.

Since thermal reactions of two or more substances interfere with each other, it may be seen from Figure 5 that if all three clays were mixed, the stronger reactions of montmorillonite and kaolinite would mask the weaker reactions of illite so that the illite curve would not be recognizable.

The area bounded by a peak and its base line is related to the kilocalories per mol of heat liberated or adsorbed. By measuring these areas with a planimeter in a series of mixtures of known percentages, a curve can be drawn relating the area to the percentage of a substance which is present. By precise measurements the presence of illite in the mixture with kaolinite and montmorillonite could be found.

The samples must be uniform, especially in particle size. Coarse particles give weak peaks and fine particles strong

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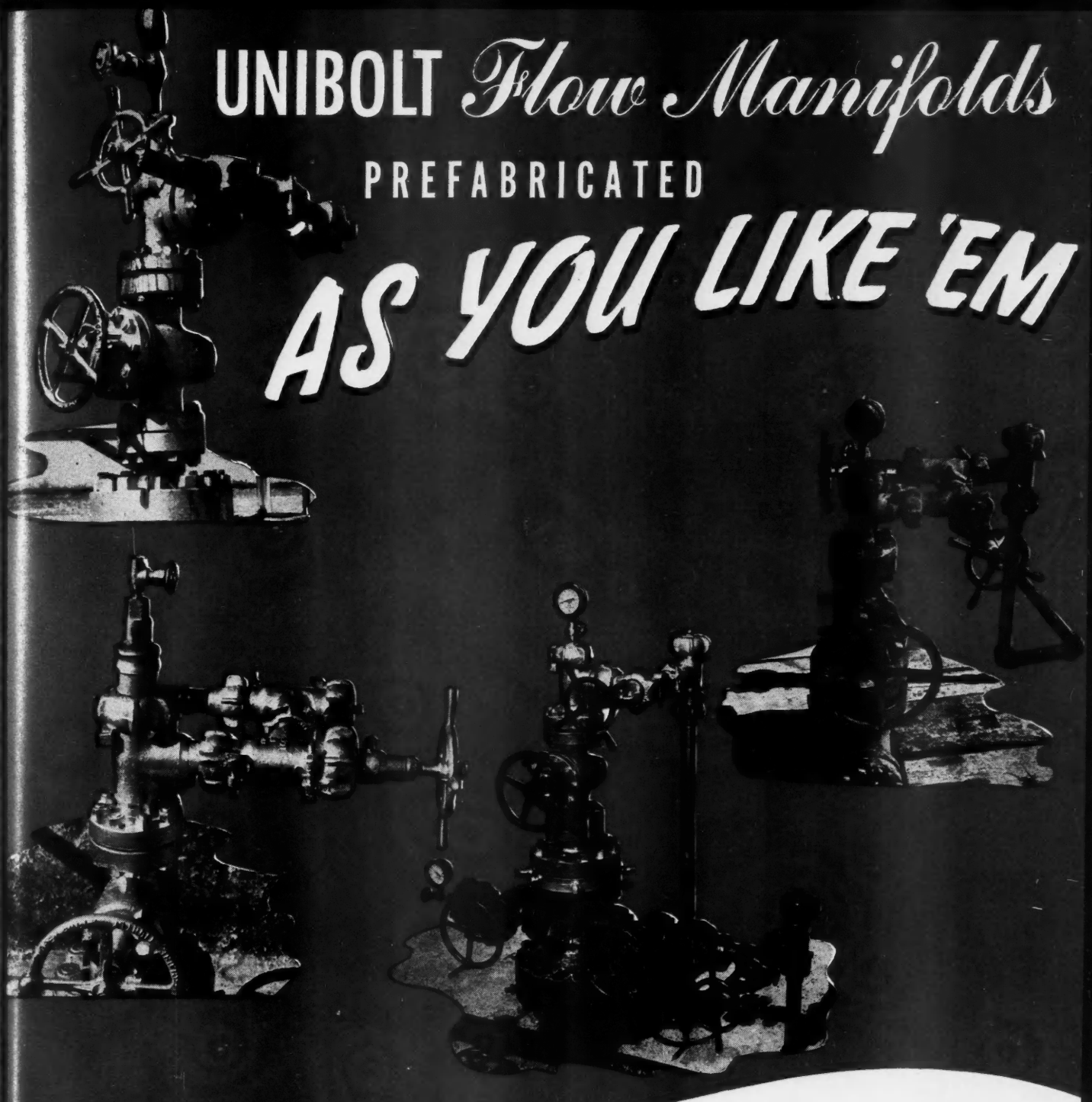

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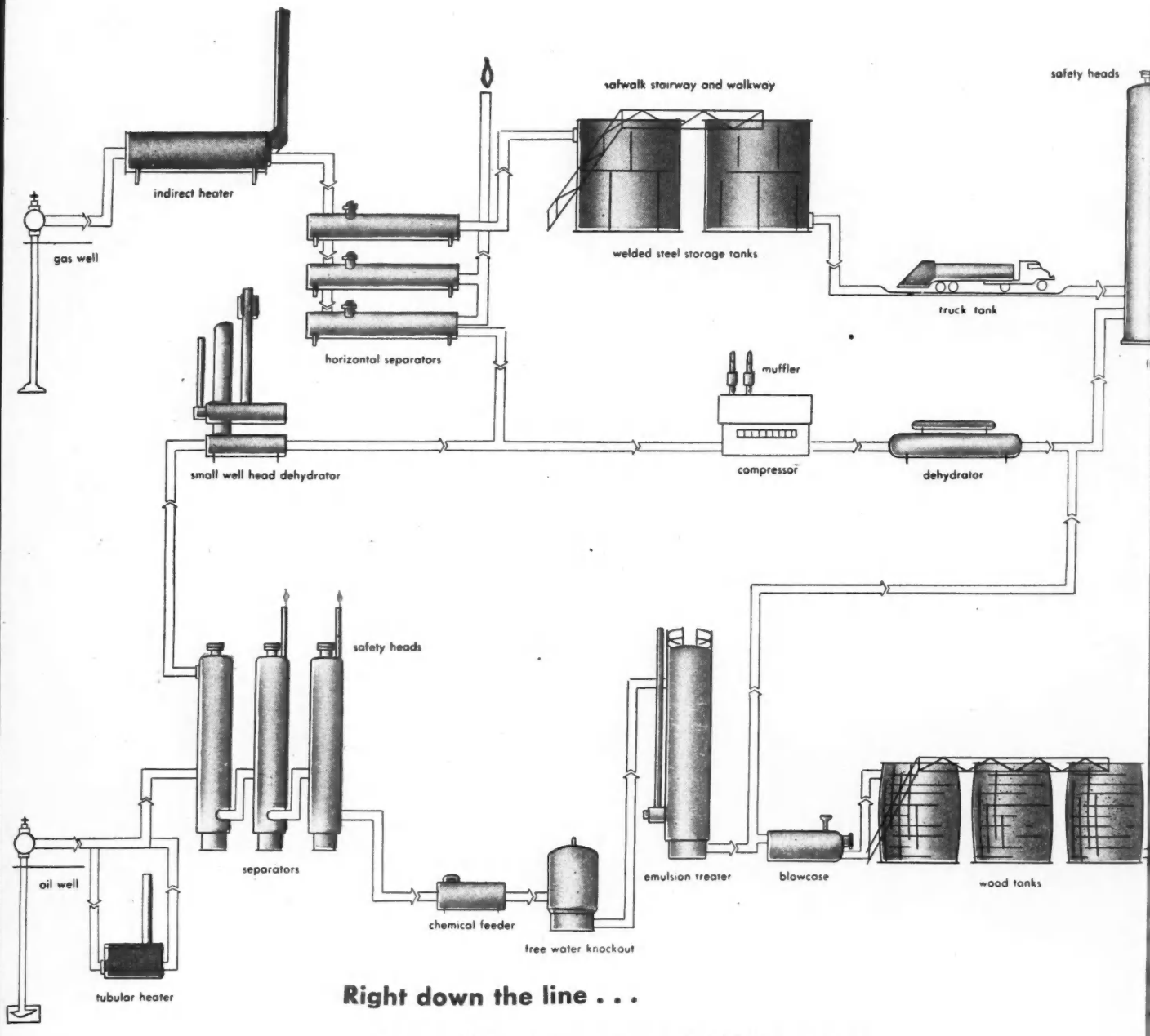

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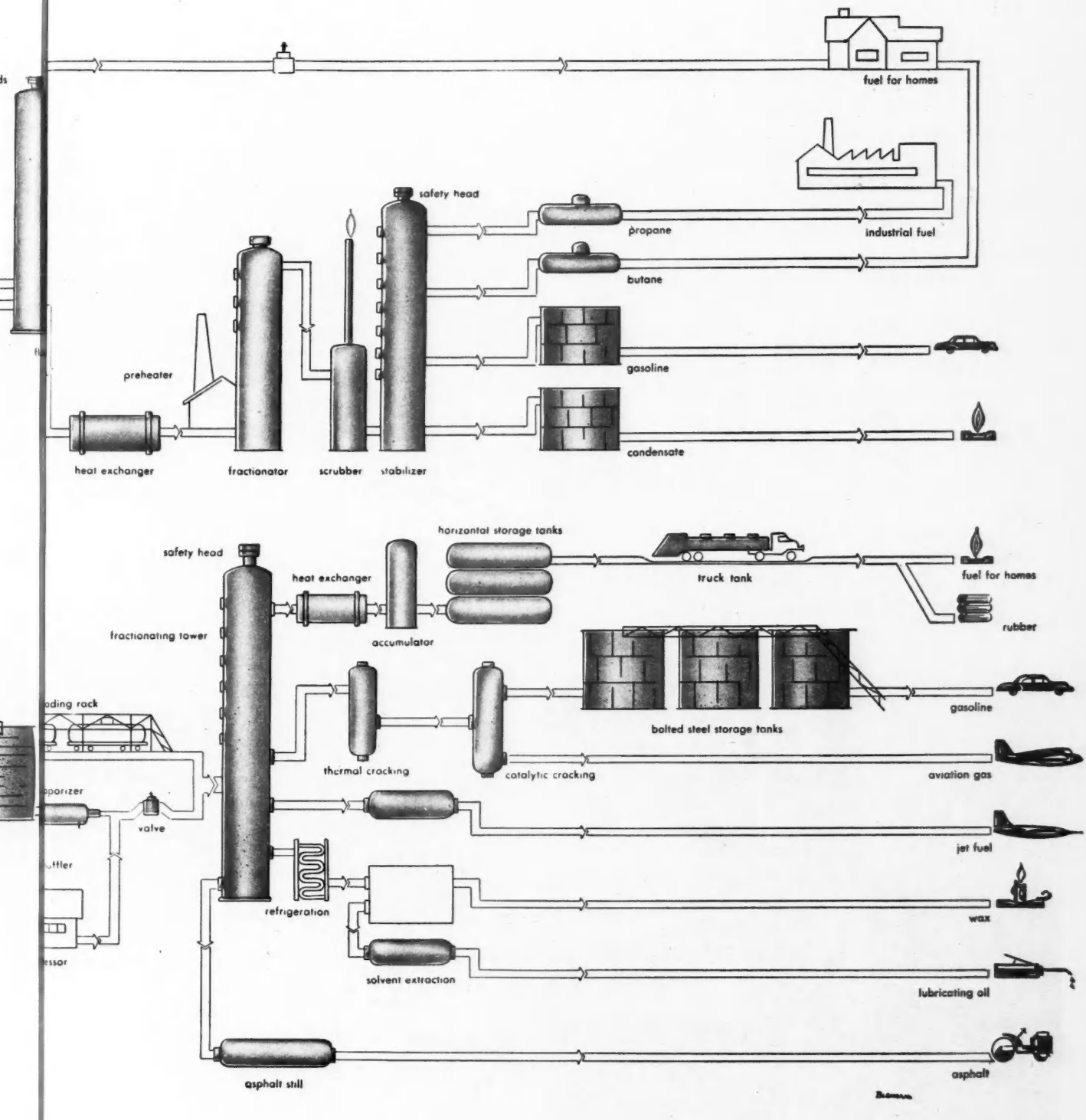
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horizontal storage tanks
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fuel for homes
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rubber
fractionating tower
accumulator
gasoline
bolted steel storage tanks
thermal cracking
catalytic cracking
aviation gas
valve
jet fuel
refrigeration
wax
solvent extraction
lubricating oil
asphalt
asphalt still

peaks. Futhermore, if quantitative data are desired, the packing also must be uniform.

The literature covering differential thermal analysis is not as yet extensive and since most workers use homemade apparatus, the data are not always comparable. It is advisable, at present, to analyze standard materials on each apparatus before the curves of unknowns can be interpreted.

X-Ray Diffraction

X-ray diffraction is used for the identification of crystalline substances which are not readily resolved by a polarizing microscope or which would require a long time to be analyzed chemically. The method is especially useful in distinguishing very fine grained materials such as clays. When a mixture of minerals is to be identified, the X-ray technique shows in what form the elements are combined. The chemical analysis, on the other hand, gives the elemental analysis from which the compounds present may only be surmised. The X-ray diffraction technique applies only to crystalline substances, because amorphous substances do not give a unique diffraction pattern.

A complete discussion of the principles of X-ray diffraction may be found in several standard reference works, such as that by Compton and Allison.[5] The beam of X-rays passes through a filter which screens out all radiation except that of essentially one wave length. The slit and collimator system in the camera forms a narrow beam of radiation which falls on the powder sample. The fine crystals of which the sample is composed under certain conditions of orientation reflect the radiation which falls on the film strip. The film forms a cylinder with the sample at its center. The sample is rotated so that more possibilities of correct orientation to give reflections are encountered. By measuring the distances between the center of the film strip and the images of the reflections, the Bragg angle[6] can be found from which the distance between like atomic planes in the crystal can be calculated. As no two crystalline compounds have the same set of inter-atomic plane distances, the X-ray pattern identifies the compound postively.

The conventional apparatus, shown in Figure 6, is a single console which contains the electrical components with the tube mounted vertically in the center of the top and projecting above. One to four cameras are arranged about the tube and are aligned with the X-ray beam, usually by means of a fluorescent screen in the exit collimator. A rotating or oscillating sample holder is in the center of the camera and can be adjusted for exact centering of the sample. The target materials used in the X-ray tube vary and three types are in general use, iron, copper, and molybdenum.

The interpretation of the diffraction patterns becomes increasingly difficult as more compounds are encountered in an unknown. A single compound is quite easily identified. Two compounds are relatively easy to identify and semi-quantitative evaluation can be made to within 5 percent or better accuracy. With additional substances present, the qualitative and quantitative results become more difficult to ascertain. The technique of X-ray diffraction, when used on natural rocks, gives information on the basic constituents relatively quickly. Rocks containing varying amounts of calcite and dolomite can be easily analyzed and approximate quantitative estimates of the percentages of these two constituents may be made. Clay minerals in shales and sandstones can be concentrated by appropriate elutriation methods and readily identified. For instance it might be of concern as to whether the clay minerals are of the swelling type or not. Clays of the montmorillonite group and illite are known to be the swelling type, whereas the kaolinite group is not. The groups can be easily distinguished by X-ray diffraction. Many other problems of a geological or geochemical nature can be solved by the application of the X-ray diffraction technique. The identification of materials is based on the spacings of the three most intense lines. A file of about 8500 cards is available which cross indexes the three principal lines of several thousand crystalline substances. A paper listing the complete spacings for 1000 chemical substances[7], and a method of indexing diffraction patterns is quite useful. The literature on X-ray diffraction is very extensive and standardization of data is established, which makes analysis by X-ray diffraction a very valuable tool.

FIGURE 6. X-ray camera is used to study crystal structure of earth minerals.

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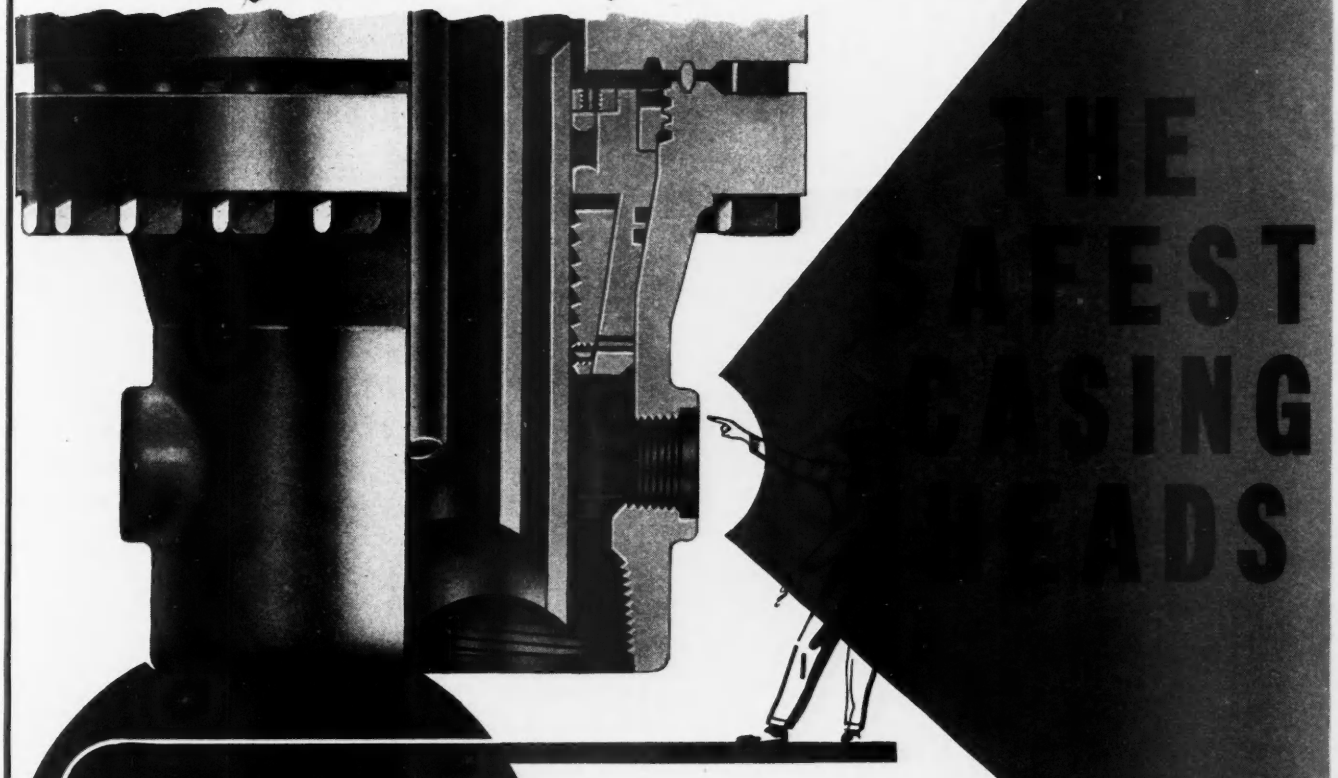

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Oil Production by Gas and Flooding

By PARK J. JONES
Consultant, Houston

Part 9

DRY AND WET OIL RESERVE FOR FLOODING

THE oil displaceable by water at a declined reservoir pressure (see Part 8), is the potential oil reserve for flooding. A potential reserve consists of dry, wet and marginal reserves. It is shown that the ultimate oil recovery for a given percent cut at economic limit varies greatly with the dry oil reserve. The latter is controllable, within the limitations imposed by structure and stratigraphy, by the location and completion of wells.

Initially in Place Oil

The acre-feet of pay per flooding unit is AH where A is productive area and H is the average pay thickness for the unit. For N injection wells per unit, there are A/N acres and AH/N acre-feet of pay per injection well. The distribution of the pay in the direction of an advancing oil-water interface varies with the shape of flooding units and with stratigraphy. Convergence is used to show the combined influence of structure and stratigraphy on distribution of pay.

The reservoir space S in barrels per unit is 7758AH times porosity corrected for interstitial water. The barrels of oil initially in place is S/b_o where b_o is the initial volume factor for oil.

Oil Displaceable by Flooding

The initially in place oil less U_g the oil recovered by gas less the correction $(20+F)\, b_o/b$ for shrinkage of the oil not recovered by gas is the oil U_o displaceable by flooding. Thus

$$U_o = 100 - U_g - (20+F)\,\frac{b_o}{b} \qquad (1)$$

where b is the volume factor for oil relative to the declined reservoir pressure at the time flooding is started. The fluid factor F is the viscosity ratio of reservoir liquid to water times the volume factor b_o. Viscosities and b_o are relative to the initial reservoir pressure.

The symbols U_o and U_g are in percent of initially in place oil. As an example, let oil recovery by solution gas be 20 percent; the initial fluid factor, five; and the ratio of volume factors, 1.2. The oil displaceable by flooding would be 50 percent of initially in place oil. However, if the initial fluid factor were 15, displaceable oil would be only 38 percent.

The influence of structure, stratigraphy, shrinkage, oil recovery by gas and viscosity on the oil displaceable by flooding can be shown by contours. Figure 9-1 is an example. Such a map is based on the following data: structural contours, pay thickness, porosity, interstitial water, position of an oil-water contact if present at the time flooding is initiated, viscosity ratio of reservoir liquid to water, oil recovered by gas, and shrinkage of the oil not recovered by gas.

The barrels of displaceable oil per flooding unit is obtained with the aid of a planimeter. Barrels of displaceable oil divided by the number of injection wells gives the average barrels of displaceable oil per injection well. Displaceable oil is the potential ultimate oil recovery by flooding. Let unity equal displaceable oil per flooding project. Then the ultimate oil recovery at abandonment is likely to be less than unity by virtue of (1) the economic limit as to water in production and (2) some of the pay may not be invadable even if wells were produced until production were 100 percent water.

Dry and Wet Oil Reserves

If no water is produced at the outset, a flooding project is said to have dry and wet oil reserves. If other things were equal, it would be advantageous to recover as much oil as possible without producing any water. Under certain conditions, however, the economics of producing wet oil have an advantage over those for maximum dry oil recovery.

Producing Rows

Figure 9-1 shows three rows of producing wells. The acre-feet to be invaded is all the pay between row 3 and the water contact. The dry and wet oil reserves for row 1 are small by comparison with those for row 3. The ratio of dry oil reserve to ultimate oil recovery for row 1 is also small by comparison with that for row 3.

Consider a reservoir with one row of injection wells along the water contact. An additional row of injection wells would split the reservoir either into two or three producing units. Suppose there are two or more rows of producing wells per flooding unit. Injection wells are located along one end or side of such units. The row of producing wells at the other end or side is the advantageous location for producing wells from the viewpoints of ultimate recovery and ratio of dry to wet oil reserves.

Interference Between Rows

Suppose the arrangement shown in Figure 9-1 were an initial producing program for pressure maintenance by water. Let the bottom hole pressure be the same for all producing wells. The per-row producing rate aside from variations in pay thickness and permeability would be about 5 : 2 : 1 for rows 1, 2 and

3 respectively. About 5/8 of the oil initially displaced by water would be recovered by the first row, 2/8 by the second and only 1/8 by the third row. If the wells along row 1 were shut in, the production would be about 2/3 for row 2 and 1/3 for row 3. These are examples of interference between producing rows for pressure maintenance.

Greater Interference

Flooding is at declined pressure and the interference between producing rows is much greater than in the foregoing example. Reservoirs to be flooded contain free gas. Free gas is displaced ahead of and along with oil. In Figure 9-1, the oil displaced by injected water prior to breakthrough into row 1 is split between the production from row 1 and the migration across row 1. But row 2 cannot produce the migrated oil until the said oil reaches row 2. In order to reach row 2, much of the free gas between rows 2 and 1 has to be displaced by oil. A similar condition would prevail if row 1 were shut in. The oil production from row 2 would be by gas only until the oil displaced by water arrived at row 2. Consequently, the cumulative oil recovery during the first few months of flooding would be greater by producing row 1 than it would be by not producing row 1.

The difference between the cost of producing wet oil unnecessarily and the cost of producing dry oil is practically a total loss. The wells along row 1 in Figure 9-1 would be shut in at breakthrough. Wells along row 2 would also be shut in at breakthrough. The invadable acre-feet of pay at abandonment of row 3 is on the order of unity. So the drilling of additional producing wells on row 3 would not be likely to pay out. On the other hand if row 3 had only two or three wells, the drilling of additional wells on row 3 would be advantageous.

A flooding unit has one row of injection wells. The number of injection wells per row varies with physical and economic circumstances. The optimum size of a flooding unit and therefore the number of existing producing rows per flood unit varies with reserve, water-injection capacity, per-injection well investment and the rate of oil production per barrel of injected water.

As intervenient producing rows can be shut in or abandoned at breakthrough, flooding projects are optimized in terms of unit invasion. This means that all the acre-feet of pay within a unit are invadable at abandonment of the last row. When the invadable acre-feet is less than unity, the acre-feet within a project should be corrected for non-invasion and

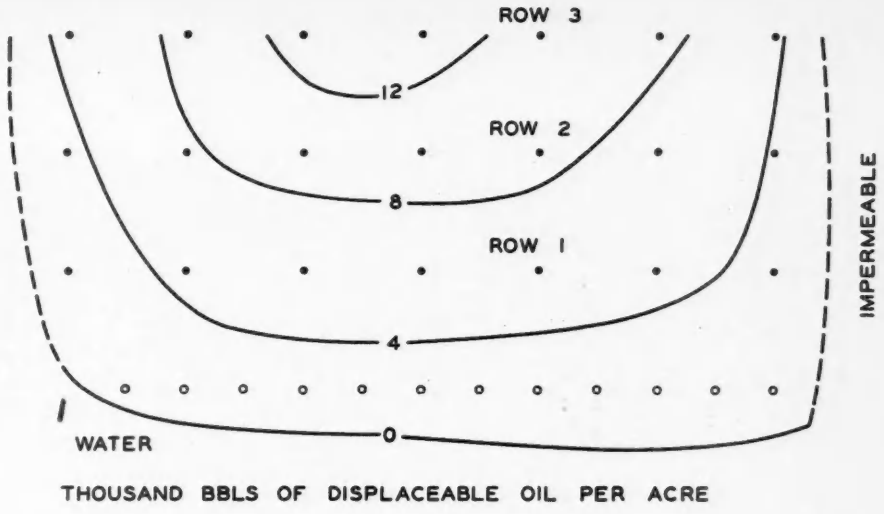

FIGURE 9-1. Barrels per acre of displaceable oil vs. position in a linear flooding unit; a row of injection wells is completed in pay and water; three rows of producing wells are shown.

for the oil retained, filtered out, by the non-invadable pay.

Migrated Water

A barrel of injected water cannot displace 1/b barrels of oil for several reasons. First, when injection wells are located along a water contact, a portion of the injected water migrates in the downdip direction. The migration continues as long as the reservoir pressure in the vicinity of the injection wells is increasing. Secondly, some of the oil displaced by water, in turn, displaces gas. Hence, a fraction of injected water is required to displace gas. Lastly, when water is produced along with oil, a barrel of water has to be injected per barrel of produced water in order to maintain an oil producing rate.

When a row of injection wells is located on the boundary between two flooding units, it is desirable to know what fraction of injected water is forced into the respective units. For the purposes of this work, injected water will be expressed in terms of the water forced into a flooding unit.

The difference between injected and produced water is called retained water. It is understood that all injected water goes into the unit for which injected water is intended. Retained water displaces oil and gas. Equation (1) defines U_o the oil displaceable by flooding. In order to achieve the recovery U_o, a flooding unit has to be filled with water. For this reason, retained water is called fill. The economics of flooding will be expressed in terms of the rate of fill.

The water required to fill a flooding unit is $(80 - F)\, b_o/100$ barrels per barrel of initially in place oil. The oil displaceable by flooding is $U_o/100$ barrels per barrel of initially in place oil. Hence, barrels of water per barrel of displaceable oil is given by

$$\text{Fill} = \frac{(80 - F)b_o}{100 - U_g - (20 + F)\,\frac{b_o}{b}} \qquad (2)$$

As an example, let the conditions be as follows:

Fluid factor $F = 5.0$

Initial volume factor $b_o = 1.2$

Percent oil recovery by gas $U_g = 18$

Volume factor at declined pressure $b = 1.1$

In this instance

$$\frac{(80 - 5)\,(1.2)}{100 - 18 - (20 + 5)\,(1.2)/1.1}$$

or 1.64 barrels of water per barrel of displaceable oil have to be retained ultimately. In other words, 1.64 barrels of water have to be injected per barrel of displaceable oil aside from migrated and produced water.

Free Gas and Reservoir Liquid

The total reservoir space initially occupied by a reservoir liquid is $100b_o$ percent of initially in place oil. At the outset of flooding, the reservoir space occupied by a reservoir liquid is $b(100 - U_g)$ percent of initially in place oil. Hence the free gas g expressed as a fraction of total fill is given by

$$g = \frac{100b_o - b(100 - U_g)}{(80 - F)b_o} \qquad (3)$$

For the conditions in the preceding example

$$g = \frac{100(1.2) - 1.1(100 - 18)}{(80 - 5)1.2}$$

or 33.11 percent of total fill.

The fraction of fill occupied by a

Oil Production

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Flooding is at declined pressure and the interference between producing rows is much greater than in the foregoing example. Reservoirs to be flooded contain free gas. Free gas is displaced ahead of and along with oil. In Figure 9-1, the oil displaced by injected water prior to breakthrough into row 1 is split between the production from row 1 and the migration across row 1. But row 2 cannot produce the migrated oil until the said oil reaches row 2. In order to reach row 2, much of the free gas between rows 2 and 1 has to be displaced by oil. A similar condition would prevail if row 1 were shut in. The oil production from row 2 would be by gas only until the oil displaced by water arrived at row 2. Consequently, the cumulative oil recovery during the first few months of flooding would be greater by producing row 1 than it would be by not producing row 1.

The difference between the cost of producing wet oil unnecessarily and the cost of producing dry oil is practically a total loss. The wells along row 1 in Figure 9-1 would be shut in at breakthrough. Wells along row 2 would also be shut in at breakthrough. The invadable acre-feet of pay at abandonment of row 3 is on the order of unity. So the drilling of additional producing wells on row 3 would not be likely to pay out. On the other hand if row 3 had only two or three wells, the drilling of additional wells on row 3 would be advantageous.

A flooding unit has one row of injection wells. The number of injection wells per row varies with physical and economic circumstances. The optimum size of a flooding unit and therefore the number of existing producing rows per flood unit varies with reserve, water-injection capacity, per-injection well investment and the rate of oil production per barrel of injected water.

As intervenient producing rows can be shut in or abandoned at breakthrough, flooding projects are optimized in terms of unit invasion. This means that all the acre-feet of pay within a unit are invadable at abandonment of the last row. When the invadable acre-feet is less than unity, the acre-feet within a project should be corrected for non-invasion and for the oil retained, filtered out, by the non-invadable pay.

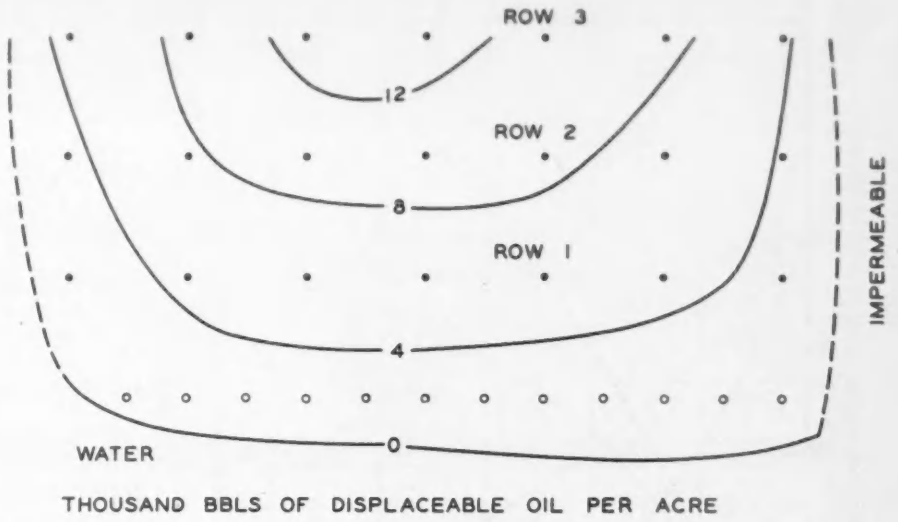


FIGURE 9-1. Barrels per acre of displaceable oil vs. position in a linear flooding unit; a row of injection wells is completed in pay and water; three rows of producing wells are shown.

Migrated Water

A barrel of injected water cannot displace 1/b barrels of oil for several reasons. First, when injection wells are located along a water contact, a portion of the injected water migrates in the downdip direction. The migration continues as long as the reservoir pressure in the vicinity of the injection wells is increasing. Secondly, some of the oil displaced by water, in turn, displaces gas. Hence, a fraction of injected water is required to displace gas. Lastly, when water is produced along with oil, a barrel of water has to be injected per barrel of produced water in order to maintain an oil producing rate.

When a row of injection wells is located on the boundary between two flooding units, it is desirable to know what fraction of injected water is forced into the respective units. For the purposes of this work, injected water will be expressed in terms of the water forced into a flooding unit.

The difference between injected and produced water is called retained water. It is understood that all injected water goes into the unit for which injected water is intended. Retained water displaces oil and gas. Equation (1) defines U_o the oil displaceable by flooding. In order to achieve the recovery U_o, a flooding unit has to be filled with water. For this reason, retained water is called fill. The economics of flooding will be expressed in terms of the rate of fill.

The water required to fill a flooding unit is $(80 - F)\, b_o/100$ barrels per barrel of initially in place oil. The oil displaceable by flooding is $U_o/100$ barrels per barrel of initially in place oil. Hence, barrels of water per barrel of displaceable oil is given by

$$\text{Fill} = \frac{(80 - F)b_o}{100 - U_g - (20 + F)\,\dfrac{b_o}{b}} \qquad (2)$$

As an example, let the conditions be as follows:

Fluid factor $F = 5.0$

Initial volume factor $b_o = 1.2$

Percent oil recovery by gas $U_g = 18$

Volume factor at declined pressure $b = 1.1$

In this instance

$$\frac{(80 - 5)\,(1.2)}{100 - 18 - (20 + 5)\,(1.2)/1.1}$$

or 1.64 barrels of water per barrel of displaceable oil have to be retained ultimately. In other words, 1.64 barrels of water have to be injected per barrel of displaceable oil aside from migrated and produced water.

Free Gas and Reservoir Liquid

The total reservoir space initially occupied by a reservoir liquid is $100b_o$ percent of initially in place oil. At the outset of flooding, the reservoir space occupied by a reservoir liquid is $b(100 - U_g)$ percent of initially in place oil. Hence the free gas g expressed as a fraction of total fill is given by

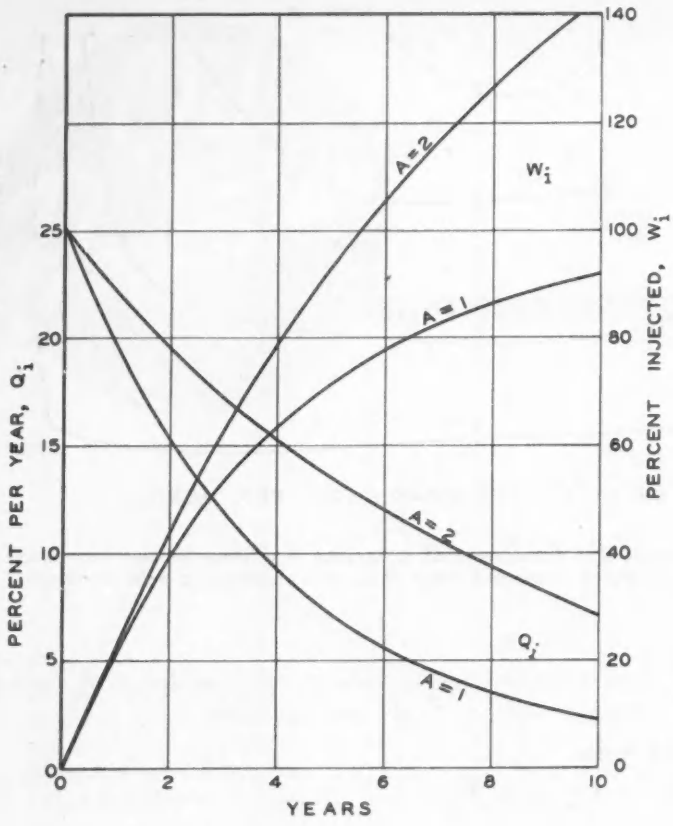
$$g = \frac{100b_o - b(100 - U_g)}{(80 - F)b_o} \qquad (3)$$

For the conditions in the preceding example

$$g = \frac{100(1.2) - 1.1(100 - 18)}{(80 - 5)1.2}$$

or 33.11 percent of total fill.

The fraction of fill occupied by a



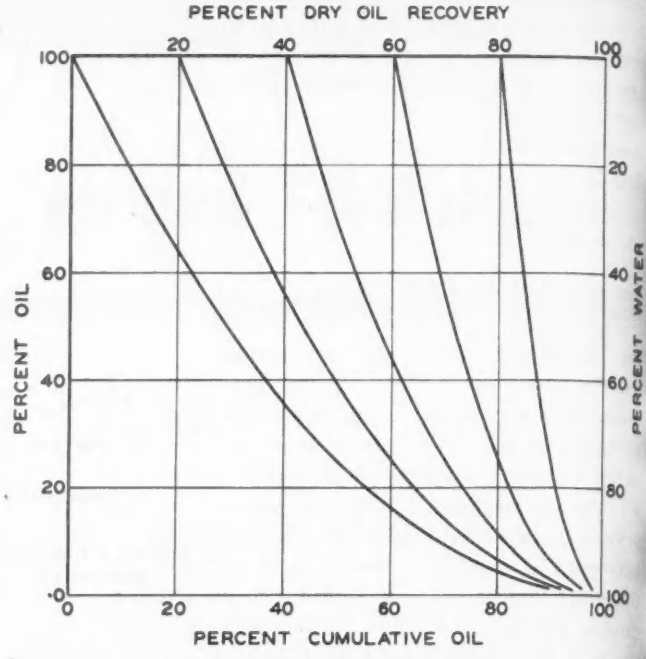


FIGURE 9-2 (left). Injection capacity and cumulative water injected for two different rates of injection capacity decline; the data are in terms of fill.

FIGURE 9-3 (above). Composition of wet oil production, barrels of oil per barrel of oil plus water, vs. dry and cumulative oil recoveries for unit invasion; oil recovery is in percent of displaceable oil.

reservoir liquid is (1 — g). When free gas is 33.11, (1 — g) is 66.89 percent of total fill. When total fill is 1.64 barrels per barrel of displaceable oil, the ultimately retained water in barrels would be 0.54 for displacing gas and 1.10 for displacing reservoir liquid for each barrel of displaceable oil.

Dry Oil Reserve

Let unity equal displaceable oil per flooding unit. Then

$$C - D = 1 - M - D \qquad (4)$$

where D is the dry oil reserve; (C — D), wet oil reserve and M, the marginal reserve. Dry oil reserve is recoverable prior to breakthrough. Wet oil reserve is the difference between cumulative oil recovery at economic limit and dry oil reserve. Wet and marginal reserves vary with dry oil reserve. The latter may be anywhere from zero to 80 percent of displaceable oil.

Dry Oil Recovery vs. Fill

Denote by unity the total barrels of water required to fill a flooding project. Let injected water, corrected for migrated water if any, be F expressed as a fraction of total fill. Let the rate of fill be expressed as a fraction per year of total fill. Aside from free gas, cumulative oil recovery C would equal fill F and the rate of oil recovery would equal the rate of fill.

But flooding projects contain free gas and the rate of oil recovery, expressed as a fraction per year of displaceable oil, varies not only with the rate of fill but also with the fraction of free gas displaced ahead of oil. Let g be the fraction to fill occupied by free gas at the outset. If it were possible to produce free gas without producing any oil, the rate of oil recovery would be zero during the time fill increased from zero to g. For a fill greater than g, the rate of oil recovery would equal the rate of fill divided by (1 — g).

In the field however, the rate of oil recovery by flooding increases from zero to some peak value before all the free gas is displaced. Moreover, the fraction of displaced free gas varies with the location of producing wells. But from the viewpoint of financing flooding projects, a conservative estimate is obtained on the basis of negligible oil recovery during the time required to increase fill from zero to about 2g/3. Accordingly,

$$C = \frac{3F - 2g}{3 - 2g} \qquad (5)$$

Solutions of equation (5) are straight lines through the points C equals zero and F = 2g/3 to C = 1 at F = 1.

Differentiate equation (5) with respect to time and note that the rate of oil recovery for F greater than 2g/3 is 3/(3 — 2g) times the rate of fill. This compensates for the oil recovered during the time required to achieve a 2g/3 fill.

The Waiting Period

Let Q_i be the rate of water injection expressed as a fraction per year of fill. If a Q_i rate of fill can be maintained for y years, the fill would be yQ_i, aside from migrated and produced water.

The months m of prospective waiting for an oil producing rate to become proportional to a fill rate is on the order

$$m = \frac{8g}{Q_i} \qquad (6)$$

where g is the fraction of fill occupied by free gas at the outset of flooding and Q_i is the average annual rate of fill. For 30 percent free gas and 20 percent per year average fill rate, about 12 months are likely to elapse.

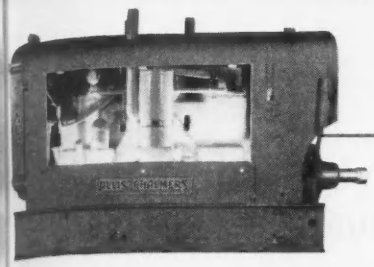
Declining Injection Rate

The maximum bottom-hole injection pressure is limited to about one pound per square inch per foot of depth to pay. Upon injection of some water, reservoir pressure increases. In addition, injection is accompanied by plugging which reduces injection rate aside from an increased reservoir pressure. If wells were operated at capacity, injection rate would start declining at the outset. The prospective rate of decline is proportional to the volume of injected water.

Let R equal the initial injection capa-

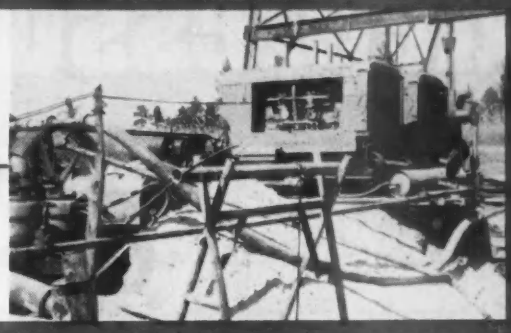
■ CONTINUED ON PAGE 18

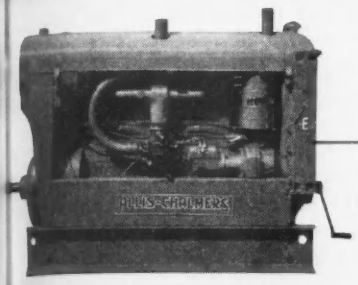
IN A POWER ENGINE UNIT?



A-C Model L844

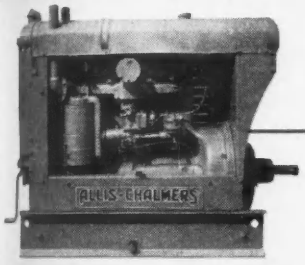
6 cyls. 5¼" x 6½"
844 cu. in. disp.
110 bhp at 1050 rpm
Torque 590 ft. lbs. at 700 rpm





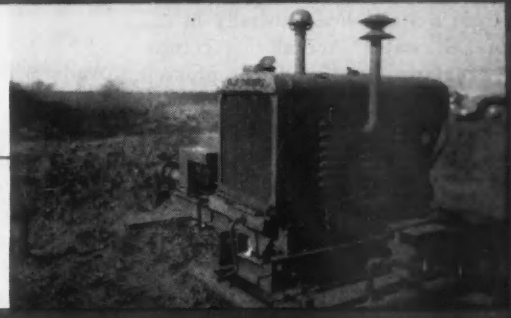
A-C Model E563

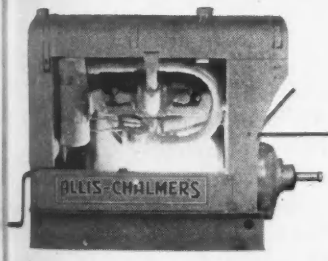
4 cyls. 5¼" x 6½"
563 cu. in. disp.
74 bhp at 1050 rpm
Torque 400 ft. lbs. at 700 rpm



A-C Model U318

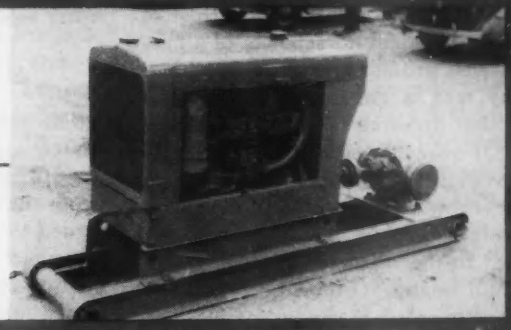
4 cyls. 4½" x 5"
318 cu. in. disp.
51 bhp at 1400 rpm
Torque 200 ft. lbs. at 900 rpm

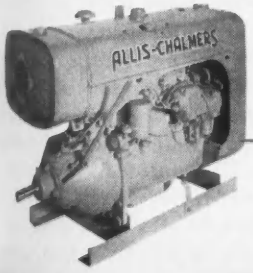




A-C Model W201

4 cyls. 4" x 4"
201 cu. in. disp.
34 bhp at 1400 rpm
Torque 128 ft. lbs. at 1200 rpm





A-C Model B125

4 cyls. 3⅜" x 3½"
125 cu. in. disp.
25 bhp at 1500 rpm
Torque 87 ft. lbs. at 1100 rpm

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Repressuring Oil Sands

By REUBEN F. THOMAS

FUNDAMENTAL PRINCIPLES governing the mechanics of reservoir behavior are presented herewith for the average oil producer and field man who has not had a "slide rule" education. The advantages of early repressuring are explained and a typical case history described.

THE value of an oil reservoir is determined largely by the potential energy stored in that reservoir. The most common form of potential energy is in the form of compressed gas, which may be in solution with the oil as well as in the gas cap. In either case, the energy represented awaits the penetration of the formation in which it is contained in order to reach the surface and attain a condition of equilibrium. A large amount of potential energy in a reservoir may result from a static head, usually in the form of salt water. Actually, a combination of static head and compressed gas are very common.

Considerable energy is required to bring oil to the surface and such potential energy, if allowed to escape, represents an even greater amount that must be replaced in order to accomplish its initial function.

The wasted energy represented by a burning flare is appalling. It cannot be computed only in terms of cubic feet of gas. The equivalent horsepower of a flare from a well producing 240 barrels of oil per day with a gas-oil ratio of 2500/1 would be approximately 1000 horsepower. If only 10 percent of this energy were available it would still represent 100 horsepower completely gone. Therefore, it is necessary that this energy be returned to the reservoir in order that a maximum quantity of oil be recovered.

Reservoir pressure can be partly maintained or restored by one or both of the following methods:

1. Artificial water flooding, which consists of pumping water into the oil formation to drive the oil remaining in the sand toward other wells which will be produced. The underground action of the water, since it has greater surface tension and capillary force than oil, pushes oil ahead of it, thus creating or restoring a certain amount of reservoir pressure.

2. Injection of various quantities of compressed natural gas into key input wells, to replenish the partly drained pore spaces and thus exert a pressure on the remaining oil so as to drive it toward wells which will be pumped or flowed naturally.

Artificial flooding has been very successful in the Pennsylvania area where the sand is hard, thick, and fairly uniform in texture and where surface water is collected to actually flood the sand. This technique obviously has serious drawbacks where the project is located in an arid region or where sufficient water is difficult to obtain.

High Stage Compressors

The most practical and generally accepted system of repressuring includes the utilization of high stage compressors using natural gas and which are designed to: (1) aid in maintaining original reservoir pressures during the flush production stage; (2) gradually restore depleted pressures in sands from which much gas and oil has been produced, pushing some retained oil toward producing wells; (3) to store natural gas.

Maintaining reservoir pressure by gas injections should be started soon after a property begins to produce, the purpose being to sustain the sand pressure as near the original pressure as possible in order to keep gas-oil ratios to a minimum and extend as long as possible the flowing life of wells. Notwithstanding high initial equipment cost, the results to be achieved justify the expenditure in increased life, higher production, increased recovery, and lower pumping cost. Early high pressure gas injection will tend to keep the gas in solution in the oil by maintaining fluidity and preventing viscosity increase, thus reducing surface tension and permitting the oil to move more easily toward the bore hole. Early gas injection will also help to control edge water encroachment.

Before undertaking a field repressuring project the operator should obtain adequate engineering data and be assured of an adequate supply of natural gas for such purposes. It is also important that compressors of suitable capacity be available. Many repressuring projects have failed because of inadequate compressor capacity. Sizes and types of compressors required will depend largely on the volumes and pressures to be handled as well as on the prime-mover equipment. Frequently, equipment intended for pressure lift can be used. Differential recording orifice meters and regulators are necessary at the compressor and at the well, and welded gas lines to and from the wells, a system of intake and discharge, and a cooling tower are frequently a part of the completed plant. If wells are flowing at a high back pressure, the gas may be taken from a high pressure separator at from 100-500 pounds per square inch. This, of course, materially assists in compressing the gas.

Among engineering problems that must be worked out is that of properly locating and spacing the recycling wells and this can best be done after a careful study of the reservoir and its characteristics. The ideal point of gas injection is at the apex of the structure where the gas/oil ratio will not be thrown out of balance and where it can be controlled more easily. An added advantage is the ability to control water encroachment which, under such an ideal condition, will penetrate the reservoir only as fast as the oil is produced and if pressure is maintained at a higher level than that of the encroaching water the latter can be held back and the voided reservoir used later as a natural gas underground storage.

If the gas were injected near the aquafer, a complete circle of input wells

would be necessary to prevent the irregular encroachment of water. The gas would flow up through the oil and dissipate itself through the producing wells. Where a steep dip occurs in a reservoir, great care must be exercised in locating input wells since the oil and gas may separate by gravity, particularly in a highly permeable sand containing high gravity oil.

The number of input wells should be based primarily upon the saturation factor of the reservoir, size of lease, texture of the sand, and the economic factors involved.

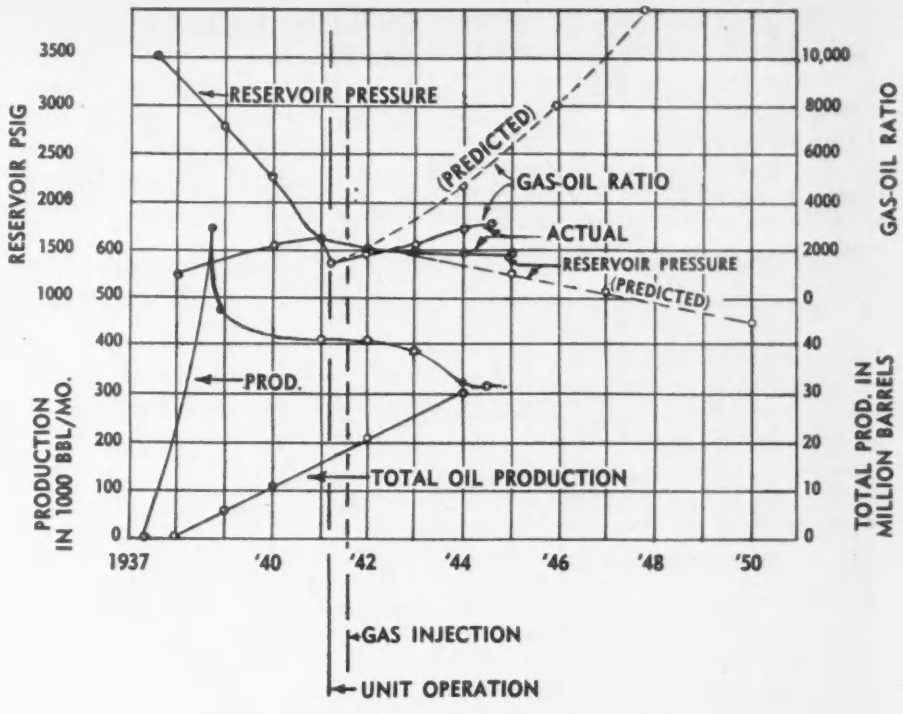
Wells chosen as input wells should be cleaned out, shot at the top of the sand, and again cleaned out. The casing should be tested for leaks and if the loss is over 10 percent, the well should not be used unless it is worked over. If the input well ever produced any water, it should be cemented off at the bottom.

When reservoirs are repressured during the flush production stage, high pressures but relatively small volumes of gas will be necessary. These must be recorded often and producing wells must be watched carefully for abrupt increases in pressure and oil production which will indicate unequal pressure distribution or channeling. If the input gas is being distributed uniformly through the sand, increased pressure and less input volume will be necessary before the offset wells show any appreciable increase in gas/oil ratio or increased oil production. A quick increase in gas/oil ratio is positive evidence of channeling and such a well should be closed or changed to an input well. In fact, where channeling or bypassing has occurred, it is best to make an input well of the one that has channeled.

Old and partly depleted reservoirs require large volumes of gas at low pressure until the drained portions of the sand are replenished, after which less volume and more pressure will be required.

Compression of the gas used in repressuring will remove liquid hydrocarbons and opinion is divided as to whether the resulting "dry" gas is more efficacious than the original "wet" gas. Wet gas goes into solution with greater ease than dry gas, reducing the viscosity of the oil in place and promoting easier flow to the bore hole. The amount of hydrocarbons that may be recovered from the repressuring media through compression may be sufficient to represent an economic return and warrant the "stripping" action, so that "dry" gas only may be returned in cycle; dry gas, therefore, may do as good a job as "wet" gas in maintaining reservoir pressure.

Theoretically, initial pressuring should recover all of the oil in a sand of uniform texture except that which is retained as a film around the sand grains. At the completion of such recovery, the sand pores should be filled with gas under a pressure in excess of the original pressure. Contributing to poor results or failure in repressuring operations are interbedded sandstones, cracks and crevices, low porosity, gas sand above oil sand, and water between oil bearing sands. Mechanical conditions which may cause a low efficiency include input wells improperly located, pressure entering some other formation than the oil sand, abandoned and improperly plugged wells, and blowouts caused by excessive pressure application.



Production history of Jones sand, Schuler field.

Method for Old Properties

On old and partly depleted properties it is good practice to inject only air, and analyze the gas from the offset wells frequently for traces of oxygen and nitrogen. This will aid in determining the major direction of the drive and assist in selecting the best wells for injection. After these two important factors have been determined, gas may be used instead of air. In many repressuring projects, 30 to 60 days may be required for pressure to build up and equalize so as to increase oil production uniformly on the average lease. This time factor is closely related to sand texture, input pressure, and distance between wells. The time required for a property to attain its peak of production after repressuring has commenced may be a matter of months or even years.

Repressuring is being carried out successfully in many areas and its application is recommended wherever possible. A good example is that of the Jones sand, Schuler field, near El Dorado, Ark. The Jones sand reservoir was discovered in July, 1937. Unrestricted production had dropped the reservoir pressure from 3520 to 1542 pounds per square inch by February, 1941. At that time, the Jones sand was unitized except for six wells. There was a differential of 550 pounds per square inch across the field at that time, the result of some wells on one side having a high gas/oil ratio. By August, 1941, when the average pressure was 1502 pounds per square inch, the differential across the field had been reduced by about 100 pounds per square inch, this result being attained by shutting in wells with high gas/oil ratios. As a result, the daily pressure drop for the field was reduced from 1.7 to .7 pounds per square inch between February 17 and July 1, 1941. At that time the operators began returning gas to the gas cap in only four wells. Within a few weeks the pressure drop for the reservoir had been reduced to 0.3 pounds per square inch per day. By the middle of 1946, the reservoir pressure was still 1484 pounds per square inch or a cumulative drop of 2036 pounds per square inch from discovery, but only 18 pounds per square inch from August, 1941. The cumulative production of gas was 75,951,601 Mcf, of which 43,965,152 Mcf was reinjected into the reservoir. The recovery per pound per square inch drop in pressure since discovery has been 18,660 barrels of oil and 37,304 Mcf of gas. Furthermore, the reservoir pressure

has been maintained virtually constant for five years while oil has been produced at an average rate of about 10,600 barrels per day.

The Jones sand has 140 producers which were unitized. It is necessary to produce from only 27 to 50 of the wells to obtain the allowable. Naturally, those with favorable gas-oil ratios are produced.

Figure 1 illustrates the results of the cooperative repressuring program in the Jones sand at Schuler.

The Arkansas Oil and Gas Commission has estimated that the application of secondary recovery methods to the Jones sand will make possible the recovery of 25 million barrels of oil which otherwise could not have been obtained.

Unitization

The great problem of repressuring operations is that of cooperation between the operators in a field. The field must be handled as a unit if success is to be achieved. Complaints usually voiced against unitization are that the operator loses control over his interests, that success is uncertain, that additional expensive equipment would be needed, that water flooding would ruin the oil sand, and that some interests may profit at the expense of others. These problems must be overcome before the industry finally accepts unitization. Louisiana and Oklahoma have passed, and the Arkansas Legislature has under consideration, legislation which would force cooperation in unitization projects after a public hearing has been held.

A recent survey by the Arkansas Oil and Gas Commission on possible secondary recovery in Arkansas shows that a minimum of from 211 million to 269 million barrels of additional oil definitely can be recovered through such methods, a figure equal to 40 percent of the oil that Arkansas had produced up to 1945. Competent petroleum engineers recognize the importance of repressuring in the early life of a reservoir and regulatory bodies are becoming increasingly conscious of the desirability of such methods in the interest of adequate conservation. Major oil companies have pioneered this trend but it remains for the individual operator or small lease holder to recognize the ultimate benefits to be derived from such practices. Universal acceptance of this and other techniques designed to effect optimum production from the nation's reservoirs will add appreciably to current reserves, bolster the national economy and make for a stronger and healthier, as well as a more profitable oil industry.

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Oil Production by Gas And Flooding

■ CONTINUED FROM PAGE 162

city expressed as a fraction per year of fill. Let A be a fraction, or multiple, of fill. Denote by W_i the injected water. Then the prospective rate of injection Q_i is given by

$$Q_i = \frac{R}{A}(A - W_i) \qquad (7)$$

The rate of increase in the volume of injected water with respect to time dW_i/dy is the rate of injection. Accordingly,

$$\frac{dW_i}{dy} = \frac{R}{A}(A - W_i)$$

Integration of the foregoing expression gives the prospective rate of injection at any time y in years. Thus

$$Q_i = Re^{-Ry/A} \qquad (8)$$

The corresponding injected water in terms of fill is given by

$$W_i = A(1 - e^{-Ry/A}) \qquad (9)$$

where e is 2.718. The symbol A represents the volume of water that ultimately could be injected into a given number of wells.

The curves in Figure 9-2 show two solutions of equations (8) and (9) for a 25 percent per year initial injection rate. If A were equal to unity, the injection rate at the end of six years would be 5.58 percent per year. Injected water would be 77.7 percent of fill. If it were desired to maintain a 25 percent per year injection rate for six years, the required number of injection wells at the end of six years would be about 2.5 times the initial number.

If A were 2.0, the injection rate at the end of six years would be 11.81 and the injected water, 105.5. If it were desired to maintain a 25 percent per year rate for six years, the required number of injection wells at the end of six years would be about 1.75 times the initial number.

Field Data

The fill at any time in the foregoing examples is the injected water less migrated and produced water. As oil production by water cannot be maintained without increasing the fill, the need for maintaining injection capacity is evident. Field data expressed in terms of fill for a given group of injection wells give a procedure for estimating the prospective capacity. Without some field data on the rate of capacity decline, the constant A cannot be evaluated accurately because of variable degrees of plugging in a given type of media. If injection is not at capacity, periodic capacity tests should be made in order to anticipate the rate of injection decline.

Composition Curves

The composition of production is the barrels of oil per barrel of oil plus water in production. Composition equals unity prior to breakthrough. The composition of production is required for estimating ultimate oil recovery and total barrels of injected water.

Denote displaceable oil by unity. Express dry oil recovery D as a fraction of displaceable oil. Let C equal cumulative oil recovery greater than D. Accordingly, (1 — D) is the displaceable oil at breakthrough and (1 — C) is the displaceable oil at any time after breakthrough. The composition X of production is conservatively defined by

$$X = \left(\frac{1 - C}{1 - D}\right)^2 \qquad (10)$$

Solutions of equation (10) are shown in Figure 9-3 for zero to 80 percent dry oil recovery. A zero breakthrough is obtained when producing wells are near injection wells. An 80 percent breakthrough is limited to crestal locations of producing wells on radial reservoirs having a pronounced convergence.

Suppose the composition at economic limit is 20 percent. For a zero breakthrough, the ultimate recovery would be about 55 percent of displaceable oil. Whereas, for an 80 percent breakthrough, the ultimate recovery would be about 90 percent.

The data in Figure 9-3 are limited to oil-producing beds. Production of water via a flooded out highly permeable bed is excluded. Coarse sand interbedded in comparatively fine sand and limestone intervals containing cavernous solution channels or wide fractures are pipelines between injection and producing wells. Isolation of pipe lines is essential in flooding.

The influence of well location, stratigraphy and pre-interval control of injection rate are reflected in dry oil recovery. However, the influence on ultimate oil recovery of the oil recovered by gas, viscosity and shrinkage is absorbed in the estimate of displaceable oil. Hence, the data in Figure 9-3 are not a comparable basis for two flooding projects having the same breakthrough but different fluid properties and unlike oil recovery by gas.

Composition curves similar to, but less conservative than, those shown in Figure 9-3 have been derived from relative permeability data. However, applications of composition curves based on relative permeability are laborious and therefore are not included here.

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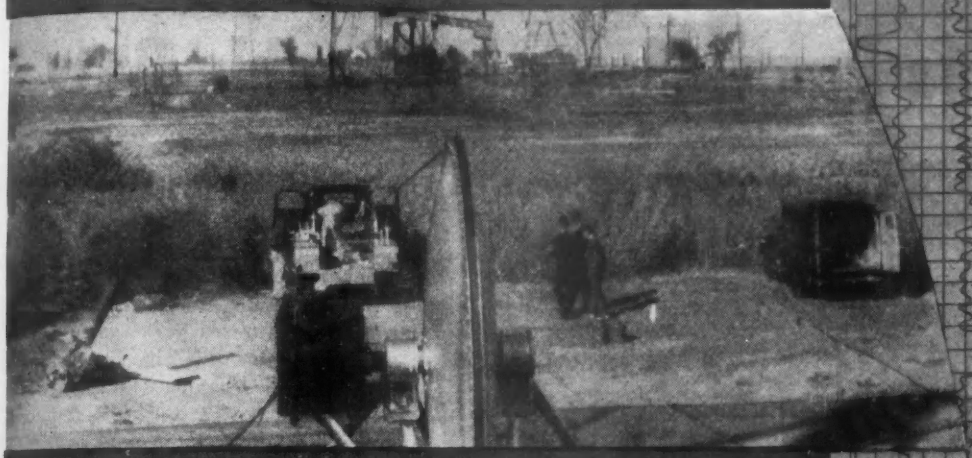
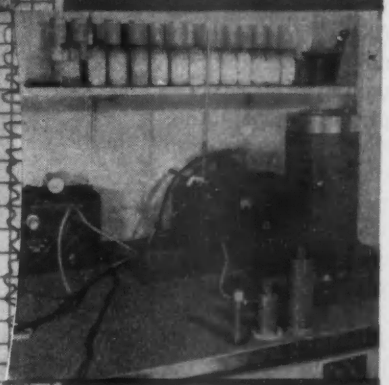


This was the first WSI Radioactivity Well-Logging unit placed in commercial service. It is shown on the well that proved the practical and economical application of the service.

Ten years of research and 20,000 commercial Well Logs have been run. Gamma Ray and Neutron logging was originally intended for use in the process of rehabilitating depleted oil fields. While the service is still used in such endeavor its greatest application is now as a necessary adjunct to drilling.

Gamma Ray and Neutron Well Logging is now available from some fifty, conveniently located points in the United States, Eastern and Western Venezuela, and Southern Argentina.



The Well Logging Unit shown here is the thirty-ninth unit built for Lane-Wells Company.

Radioactivity well logging service is available from these experienced licensees. . . .

Well Surveys, Inc.

TULSA, OKLAHOMA U.S.A.

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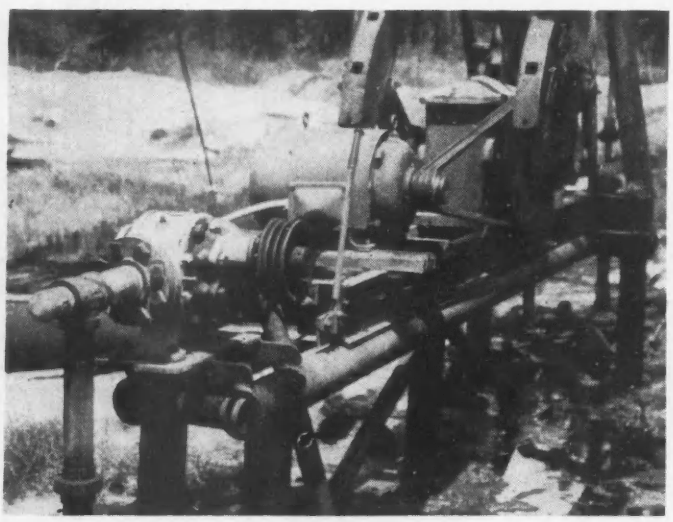
UNITED STATES
SEISMOGRAPH SERVICE CORP.
of Delaware
CARACAS, VENEZUELA
GEOTECNICA, S. A.
BUENOS AIRES, ARGENTINA

HOW TO—Arrange Pump Motor for Double Duty



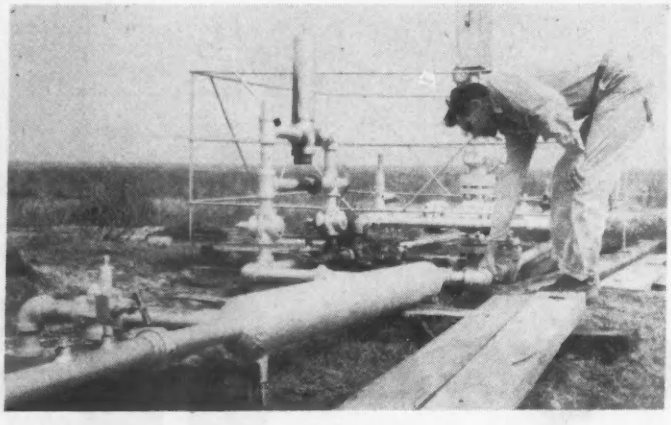
An operator in North Louisiana saved the expense of a prime mover for one isolated well and tank battery by utilizing the electric motor on the pumping unit to drive a rotary gear pump. Eliminating the need for a second prime mover for the oil pump was accomplished by mounting the rotary gear pump on the same foundation framework on which the pumping unit and electric motor were mounted.

In this application, oil was pumped from the well into a nearby tank. When the tank was full, the pumper shut down the pumping unit and removed the three V-belts from the gear box on the unit. The motor setting could be easily changed, and the belts were quickly slackened. The belts were then threaded around the three-groove pulley on the rotary gear pump and the motor pushed away to tighten the belts. Suction valves on the pump were opened and the motor started. The electric motor then powered the rotary pump to move the oil to a larger tank battery where a larger pump placed the oil into the pipe line.

The framework on which the unit was mounted consists of salvaged four-inch pipe set in concrete and braced in the middle by an additional vertical post. One end of the longitudinal member is open to permit the storage of two extra V-belts for standbys in case one of the active belts becomes shredded or broken. A simple platform for the rotary gear pump was fabricated from half-inch sheet metal and bolted to the pipe framework.

Because of its relatively small size, the pump could be mounted on the pumping unit, providing an arrangement whereby the same electric motor could be used for dual purposes.

HOW TO—Warm Lifting Gas With Heat Exchanger



Where regulators and chokes were freezing up, and at the same time the well was making production near the 100-degree mark, one company engineer made a jacket to go over the gas line on the upstream side of the choke or regulator. This bath of crude and warm salt water was sufficient to overcome the freezing condition of the regulators or chokes.

The exchanger was made in the company shop by orange peeling a six-foot piece of five-inch casing over a piece of 2½-inch pipe, the size of the high-pressure gas lines. Unions were placed on either side of the line and two-inch side connections were made on the five-inch nipple for the flow line from the well head. The assembly was then brought to the field and connected so that production went around the outside of the gas line and the gas directly through the exchanger. The choke or regulator (choke in this case) was placed just ahead of the exchanger so that as the fluid flow warmed the gas line, it also conducted heat directly to the constriction. Although the gas line frosted at times, it never became cold enough to form hydrates.

The full meaning for you of the

NEW COMBINED SERVICE DEPOT

Dresser Industries has established a new warehouse at Houston, Texas. It stocks equipment and replacement parts. It houses new offices for the convenience of the customers of:

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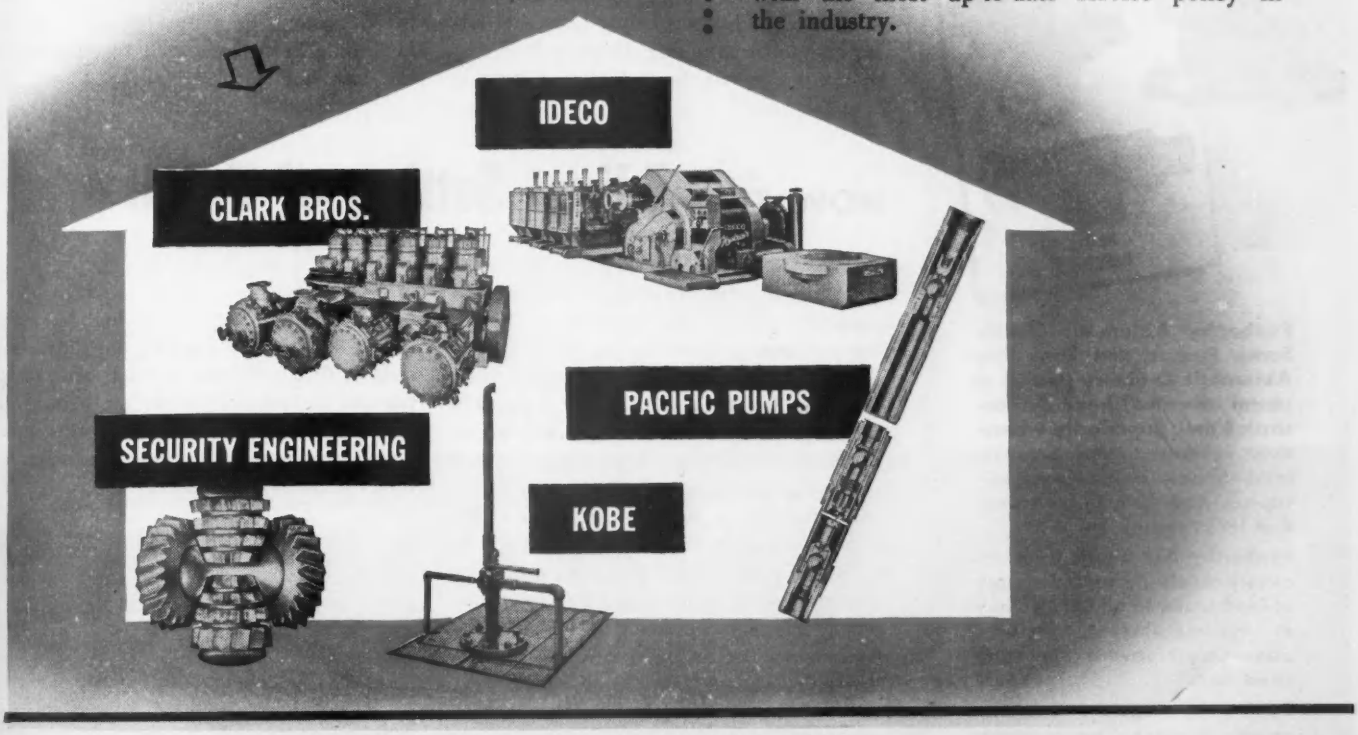
It is another example of Dresser policy . . . constantly expanding service facilities to keep pace with sales. When you think of Dresser Industries think of it as the company which recognizes that service to the oil industry is as important as new products to sell.

When you buy from any of the companies grouped within Dresser Industries, buy with assurance that your equipment is backed up with the most up-to-date service policy in the industry.



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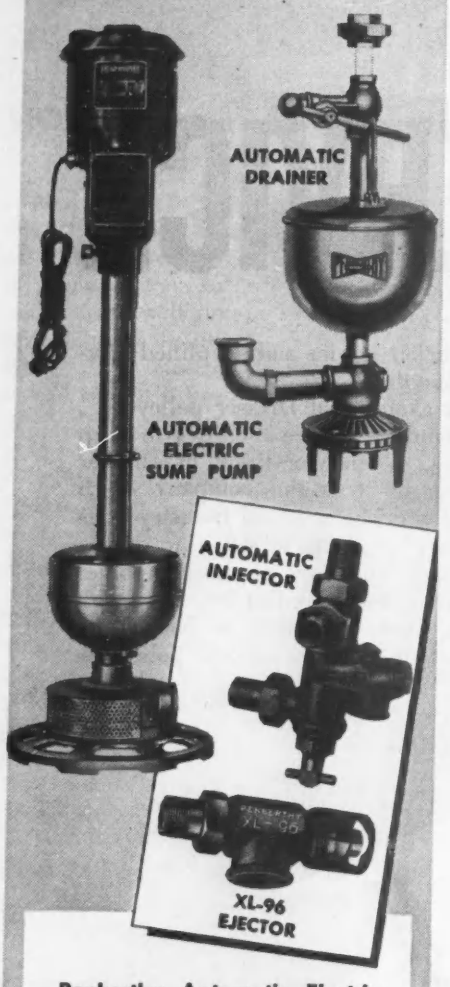

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3277-A

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
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HOW TO—Pipe Pulling Unit Exhaust

Regardless of the condition of the engines, the fuel mixture changes frequently in gas-air ratio due to the fluctuation in power requirements and speed. At various times during the workover, or pulling operation, the exhaust carries quantities of carbon monoxide and other disagreeable fumes, as well as back fires from the engine. So that the crew can work in comfort and safety, the exhaust gases can be piped away from the unit with flexible steel hose.

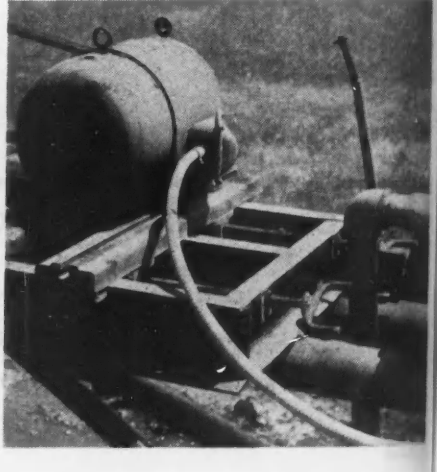
Mufflers on the exhaust manifolds are installed in a horizontal position so that the tail pipes point to the side of the unit opposite the position of the machine operator. The tail pipes in this installation are pipe nipples, welded to the head of the muffler, so that an ell can be attached looking down and carrying a swedge nipple to attach the steel tubing. The swedge nipple and the tubing have an area sufficiently large to conduct the exhaust away from the muffler without excessive back pressure so as not to reduce the efficiency of the engines. The steel tubing is long enough for the outlet end to be at a safe distance from the men working on the well. Being light in weight and flexible, the pipe can be laid at any angle to the pulling unit to point down wind so that the fumes may be dissipated quickly. In case of back fires, the open ends of the exhaust tubes are far enough from the well to eliminate a fire hazard.

HOW TO—Adjust Setting of V-Belt

The ease with which the pumper can properly adjust the tension in V-belt drives usually contributes substantially to the life of these belts. Throughout the pumping life of a well, many belts will be used. And, if these belts are exposed to the weather, they will stretch some, making it necessary to take up the slack.

Illustrated is a simple, convenient method to adjust quickly the tension in a V-belt drive on one pumping unit. The electric motor is mounted on two metal cross members which slide on the I-beam runners of the pumping unit frame. At the end of the frame, two holes were cut to accept a long screw stem which extends to the edge of the motor mounting members. A forked handle is welded to the end of each screw stem to facilitate tightening or loosening the nut which is placed on the outside of the I-beam frame. The screw stems are attached to the cross member of the motors by a bearing joint which permits the stem to rotate but holds it to the cross member.

The pumper could take up any slack in the V-belts by holding the adjusting nuts with a crescent wrench and rotating the forked handles in the proper direction. By adjusting each screw stem a few rotations alternately, an even adjustment could be made.



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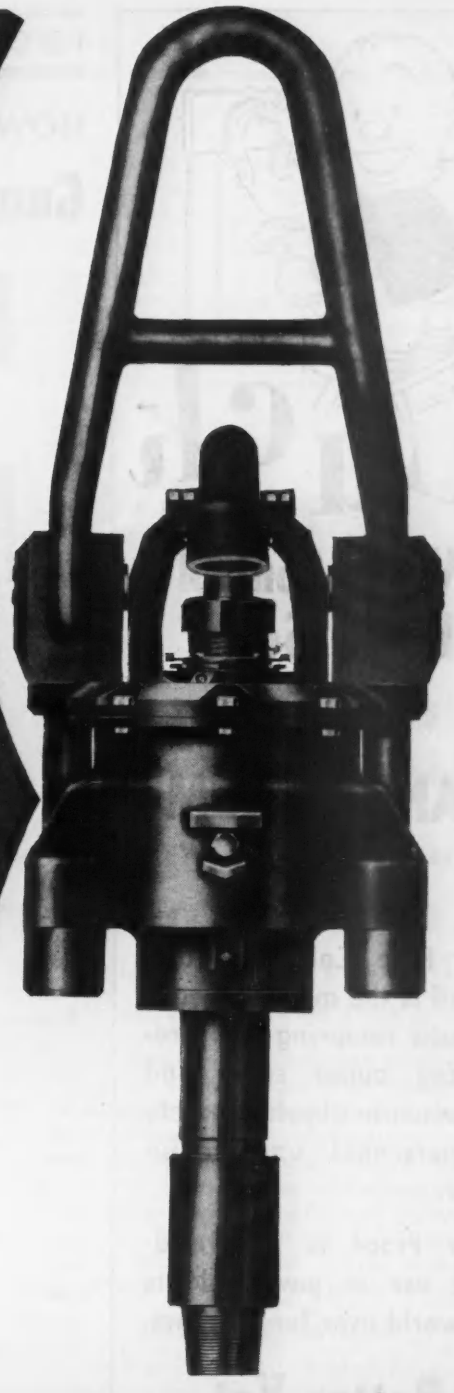
This Original Design positively prevents distortion



Because the load is carried from the bottom, Gray Rotary Swivels give MORE STRENGTH with LESS WEIGHT

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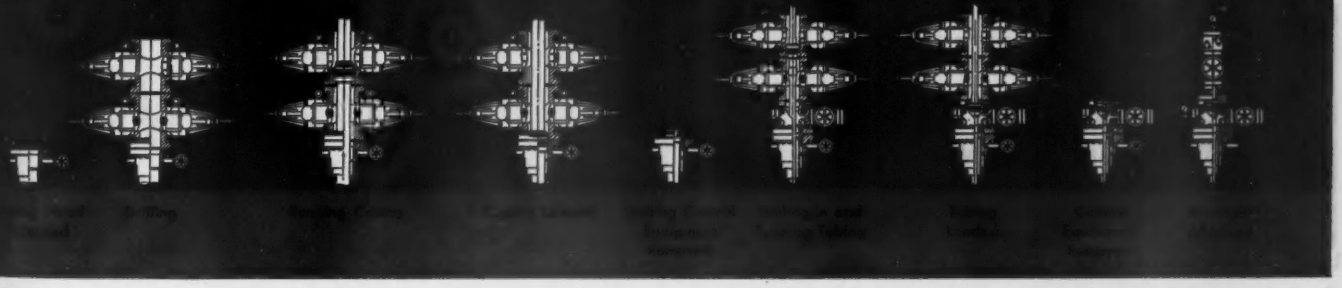

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PRODUCTION HINTS

HOW TO—

Guard Filler Neck

In the work of building up a truck-mounted pulling unit it was found that while the fuel tank could be protected adequately by mounting it behind the cab and beneath a section of steel plate walkway, it was not convenient to provide protection for the unprotected filler neck. In order to protect this vulnerable point from accidental damage, yet be able to uncover the neck easily for re-fueling, the welder designed a hinged plate which serves both as a protective cover and a step plate. Cut out of one-fourth inch floor plate material, the small cover, shown in the accompanying photograph, has welded to its under side, and at right angles to that surface, a segment of plate which provides a brace adequately strong to support the weight of a man as he steps up on the plate.

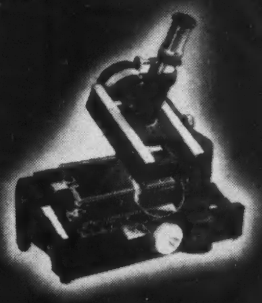
HOW TO—

Drain Pump Waste

A waste and drippings collecting system at various points on a centralized pumping unit or other power installation will repay its cost many times over in reduced cleaning and maintenance costs, to say nothing of benefits realized through reduced fire hazards at the site. A small, unusually efficient waste collecting system installed by one company on each of their centralized units, is illustrated.

At three points, two at the pumping unit, and the other beneath the crankcase of the engine, small collecting basins

For Reading Bottom Hole Pressure Charts



For accurately reading bottom hole pressure gage charts. One inch travel on pressure scale readable to 0.0001 inch. Sixty power microscope. Four inch travel on time scale read with scale and vernier. Shadowless illumination. Available with 2 inch or 50 mm travel of microscope.

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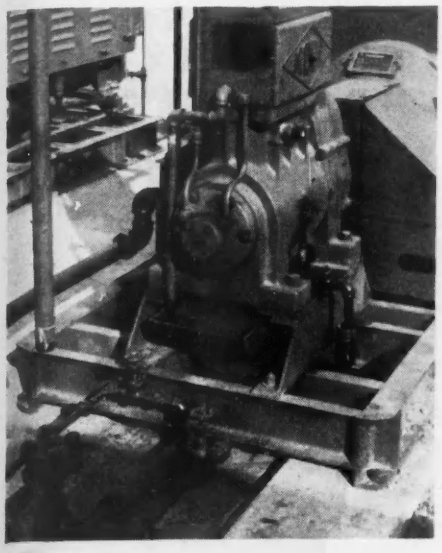
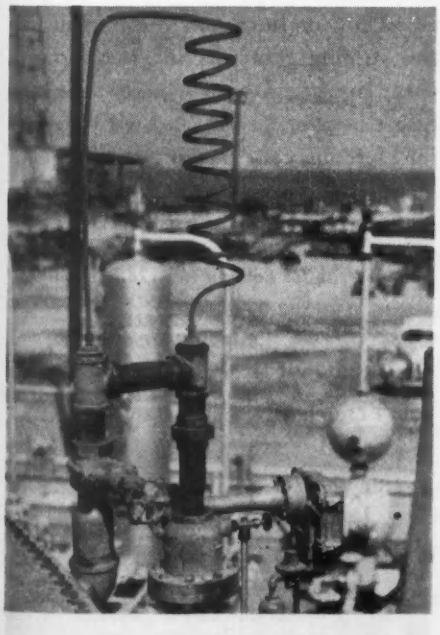
or upturned swage nipples are positioned so as to catch all drippings or crankcase drainings. Fluid caught at these points



flows into a common two-inch line running the length of the unit bases, emptying into a sump at the end of the installation.

HOW TO—
Regulate Surge

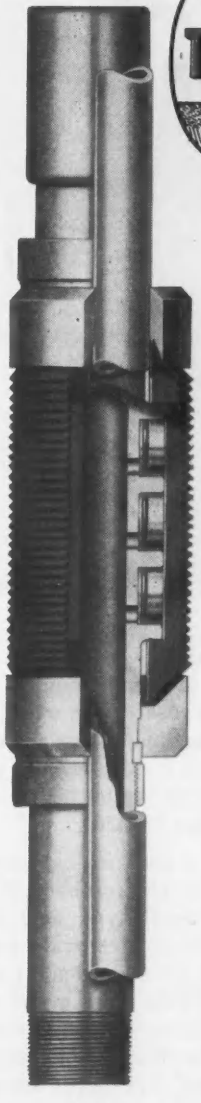
It has been found that when a number of wells flow through separators into a single stock tank, the pulsation rhythm sometimes causes wave actions in the tank that create a false level in the automatic instrument which switches to an



empty tank when a predetermined volume of oil has been placed in the tank. To dampen this surge and to cause a mean level to appear in the body of the "kidney valve" chamber, several extra fittings are attached to the upper connection of the level control body.

In the tees employed to complete the pipe work, conventional copper tube fittings are attached so that a compensating copper line will carry the vapors to and from the liquid level control. The line is formed as a helix in one leg to prevent vibration breaking the tubing and to provide sufficient "spring" in the line to permit removal without distortion or breaking.

As an additional means of controlling the flow of vapors to and from the top of the chamber of the control instrument, a suitable orifice plate is inserted in one of the tees below the ⅛ x 2-inch cast iron plug which contains the fittings for the copper tube to provide the lag necessary to maintain a quiescent level in the float chamber.



PAGE TYPE "C" TUBING ANCHOR

PAGE TENSION TOOLS

NOTE ...TO "FREE PUMP" OPERATORS!

SMOOTH OUT YOUR TUBING TROUBLES with this PAGE TYPE "C" TUBING ANCHOR...

It's designed for parallel strings!

The Page Type "C" Tubing Anchor is designed specifically to anchor parallel strings in "Free Pump" installations. Its advantages to operators are many. The Page Type "C" Anchor *assures* a fast tubing run-in without danger of accidentally setting slips, *eliminates* the human element of top-hole manipulation in setting and *saves* valuable time in landing tubing strings. The Page Type "C" *relieves* tubing of fluid and working pressure loads and *increases* the factor of safety in long tubing strings. It enables running longer strings of second grade tubing because the Type "C" *supports* the tubing and holds it in tension, free of "working" loads.

SIMPLE OPERATION

The Page Type "C" Tubing Anchor sets hydraulically on fluid pressure differential. The hydrostatic head of oil in the power string together with the "free pump" surface operating pressure, forces a series of small pistons against v-cut slip segments that grip securely against the casing. Holding power of the slips far exceeds fluid head and operating pressure loads. Release and removal from well requires only drainage of tubing. Tool can be run-in either end up.

SIMPLE CONSTRUCTION

Anchor Body made from a solid billet of steel . . . working force consists of two v-cut slips and six pressure-sealed pistons . . . all parts replaceable and interchangeable.

WRITE now for details or see . . .

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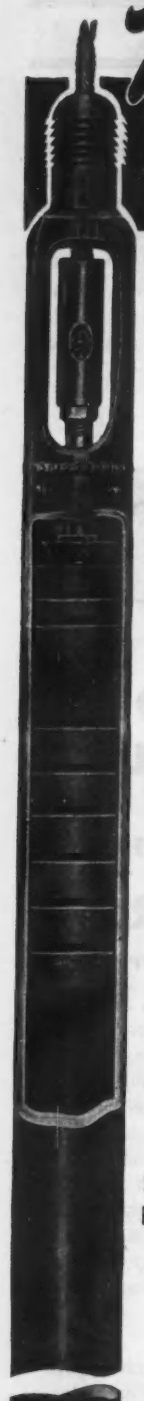

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Standard Clean-out Tool for 25 Years

Check any oil field in the world where sediment or sand is met with and you'll find Miller Sand Pumps and Bailers are standard . . . leadership earned and held by continuous improvements during 25 years of service!

The Miller Sand Pump is made in Regular and Heavy Duty types in sizes listed below. Lug type Chisel, Sand and Bailer Bottoms are easily interchanged.

Threaded Chisel and Sand Bottoms can be supplied, to permit larger pieces of sediment to pass, and pump to be dumped without removing bottoms. Tool Pin bail allows tools and sand pump to be run on same wire line when desired.

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue page 2666 for details.

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Outside Diameter
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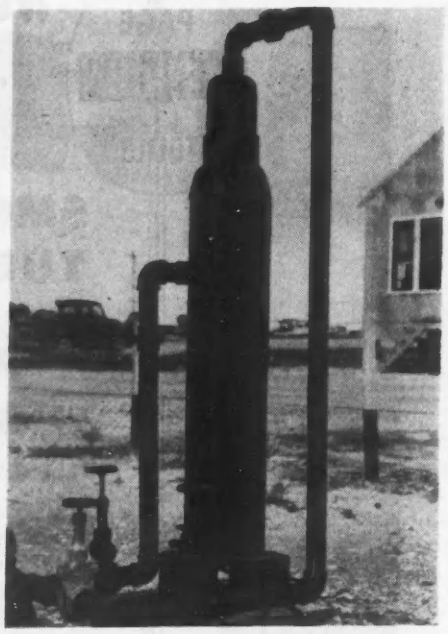
PRODUCTION HINTS

HOW TO—

Clean Gas Safely

Field gas taken from separators must be further cleaned if it is to be used efficiently in heaters for the treatment of emulsions. Common practice is to place an ordinary scrubber in the heater gas line, taking the discharge from the top



of a vertical chamber. Unless constant attention is given this type scrubber, it may fill with condensate and overflow into the heater gas line. These liquids clog up the burners in the heater, and sometimes overflow in the burner boxes, creating a serious fire hazard.

Protection against such incidents was provided by the simple scrubber illustrated. It is the usual type field gas scrubber, consisting of a vertical chamber, with the inlet above mid-point and the outlet on top. Drain plugs are at the bottom. A unique feature of this scrubber is a spherical metal float placed inside the vertical cylinder. The upper section of the scrubber has been belled down and a smaller section of casing added to form the top. A nipple was welded to the belled section, so that its lower edge extended into the cylinder about five or six inches. This extended edge formed a seat upon which the float rested in the event the chamber filled with liquids to this point. The float, when seated at the upper end of the scrubber, would shut off the flow of gas entirely, giving warning of what has happened.

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Designed with a minimum of parts for easy installation and economical operation. This new lubricating gland lengthens the life of the rod or liner as well as the packing in the stuffing box. On various tests, the life of the polished rod or liner and the packing in the stuffing box was increased many fold. Equipped with a zerk fitting to insert bearing grease and with a regular Hercules cone packing ring, serving as a wiper ring. Fits all type Hercules stuffing boxes now in use.

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Economic Sizing of Oil Pipe Lines

DEVELOPING ENGINEERING data which will enable an optimum size of line to be selected to meet predetermined throughput requirements, the author presents a series of charts which will greatly simplify the preliminary work of line size selection and afford a workable basis whereon can be superposed the individual requirements of terrain, and other variables introduced by local conditions.

By F. C. WHITESIDE
Interstate Oil Pipe Line Company, Tulsa

WHEN a new pipe line is under active consideration, several difficult factors present themselves for appraisal before the particular line design can get under way at all. They include the estimation of the peak production from the area, the estimation of the demand from the new area into the various refinery and consumer sections tributary to it, the estimation of the proportion of the total production that will move in the direction under consideration for the new line, and finally the estimation of what part of this movement the proposed line will be called upon to transport.

What size of line to lay into the new area then comes into the picture, and this is always a difficult decision to make. The cost of oil transportation by pipe line decreases greatly with increased volume. The most economical line would therefore be the one just adequate to carry the peak throughput from fully developed production. Inadequate lines result in wasteful additions to the original plant as subsequent development occurs.

On the other hand the forecasters of the reserves in new discoveries are forced to limit their estimation of the producing area practically to proven acreage. Still, early in the development period, pipe line outlets have to be provided so that appropriation of funds for laying them partakes of the nature of appropriation of funds for the original exploratory expenditures and for leasing. That is, appropriations will be made that are based partly on faith in the area. There is more basis than for the exploration costs in that oil will have already been discovered, but the volume of production for which transportation should be provided will not usually be defined for several years. With the best of planning, this is always a serious problem and requires the best application of business foresight. The seriousness of this situation can be emphasized when it is pointed out that practically every pipe line system of any extent built prior to the war was built too small. How this came to be can be understood by a retrospective glance.

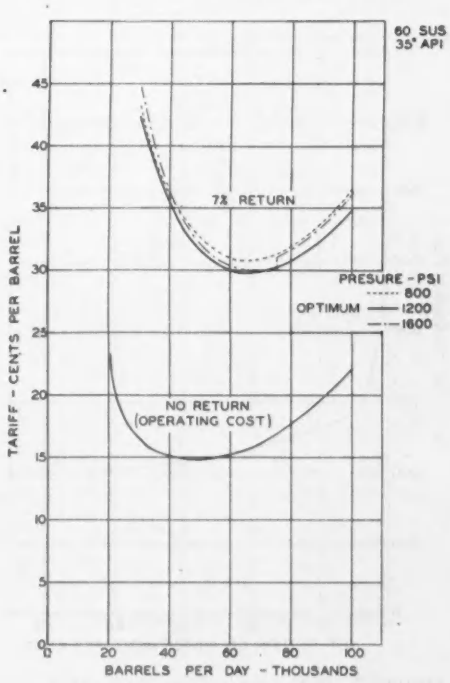


FIGURE 1. Tariff required for 12-inch line.

In the early days of the oil business the unrestricted volumes from producing fields forced the feverish construction of pipe line outlets without adequate foresight in their planning. The high cost of overland transportation of oil by any means other than pipe lines made the pipe line rates of even such inadequately planned projects look cheap in comparison. The cheap appearing rates that still resulted in attractive profits provided inadequate economic compulsion for long range managerial planning. Whatever installations were built in most cases paid out all right, and it is unusual for owners to apply critical interest toward how an enterprise is designed and run when this enterprise is paying satisfactory dividends.

By far the greatest part of a pipe line

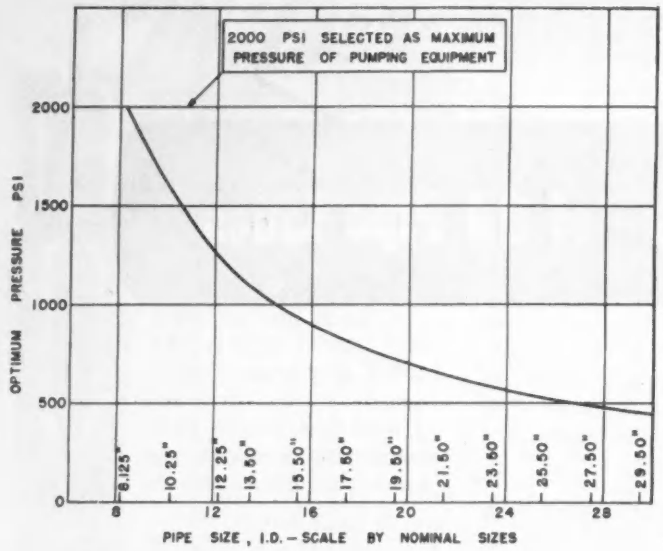


FIGURE 2. Optimum pressure for 7 percent net return.

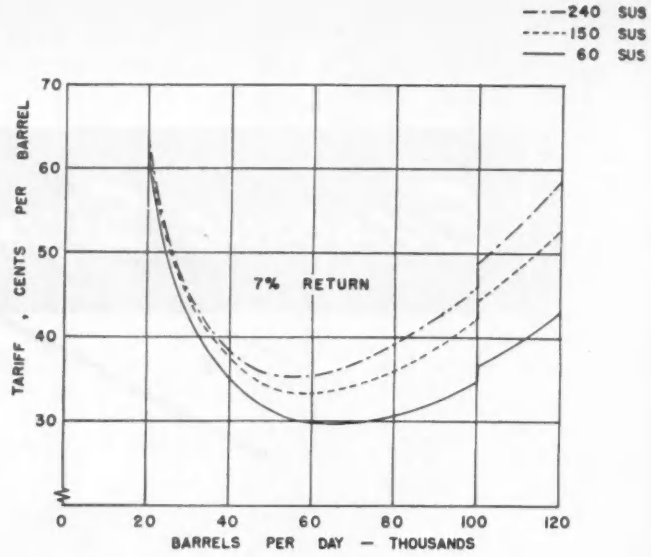


FIGURE 4. Tariff required for 12-inch line at optimum pressure, 1200 pounds per square inch.

system investment is in the lines themselves. In view of this and the natural difficulty in appraisal of the throughput from a new area at the start, and of the absence of economic compulsion to develop the basics of pipe line economics, it is easy to see why lines were practically always laid too small. This resulted in station spacings which were too close, operating costs which were too high, and subsequent wasteful loopings of the pipe line system as development progressed.

Competition Heavier

Trends long prevalent in the pipe line industry are now effecting a vigorous economic squeeze upon the transportation companies. Improvement in design and operating practices in some companies has injected heavier competition into the rivalry between lines transporting oil in the same general direction which has driven tariffs downward just as persistently as wages and material costs have been rising. The most efficient pipe line systems with the longest hauls and largest throughputs naturally have the lowest operating cost per barrel mile. It is easy to see that pipe line systems in the same general service must meet the competition of the most efficient line.

Oil service in general the country over has been furnished without radical variations in prices so that transportation costs anywhere will be affected by improvements anywhere else.

Many papers have appeared in recent years regarding trends in pipe line design. A great proportion of these articles describes the tendencies toward larger pipe diameters, thinner walls, higher tensile strength steel, higher operating pressures, longer station spacing, more effective and efficient pipe coatings, cathodic protection, etc.

To a lesser extent, papers are encountered which deal with improvements in station design. Pump and engine speeds are being increased which allows the same output to be handled with lighter and cheaper equipment. The few large cylinders on the older type pumps are giving way to a greater number of smaller cylinders designed to give more even flow. Where oil viscosities permit it, the use of centrifugal pumps is coming into greater favor, which gives more freedom from surges.

With the practices in design in such a state of flux, it will be seen that settling upon an estimate of the expected throughput leaves many engineering investigations desirable in order to assemble cost figures for the optimum plant for the required service.

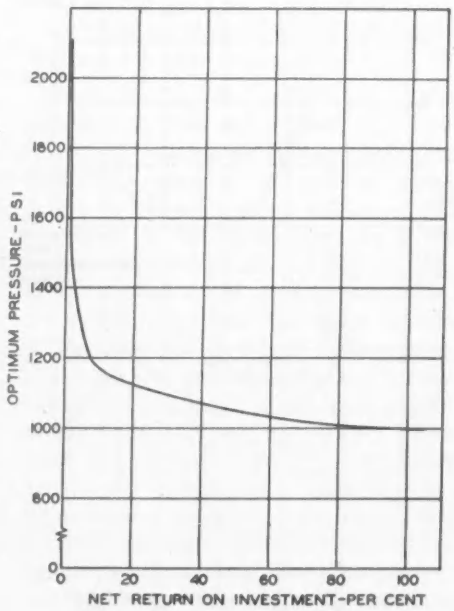


FIGURE 3. Optimum pressure for varying return on investment in 12-inch line system.

The economics and design of the line will be concerned with:

1. The length of the line.
2. The size of the pipe.
3. The minimum wall thickness at the low pressure end.
4. The tensile strength characteristics of the steel.
5. The safety factor to which the steel is stressed.
6. The price of pipe and equipment on location and the cost of construction.
7. Operating pressures.
8. Station spacing.
9. Volume of throughput.
10. Gravity of the oil.
11. Viscosity of the oil.
12. Temperatures encountered — averages and extremes.
13. Elevations along the line.
14. Operating practices and costs involved.
15. Desirable rate of return on investment.

The number of factors is so great and their inter-relationship so complicated that full generalization of pipe line estimation data has always eluded complete accomplishment. The squeeze occasioned by falling tariff rates and rising costs dictates that complete economic evaluations be made. In the old days a rule of thumb said that an eight inch line was a 20,000 barrels per day line and stations should be 30 to 35 miles apart. Recent improvements in materials, design practices, and operating procedures mentioned previously have upset the old customs, but uniformity has not emerged.

This paper proposes a method for

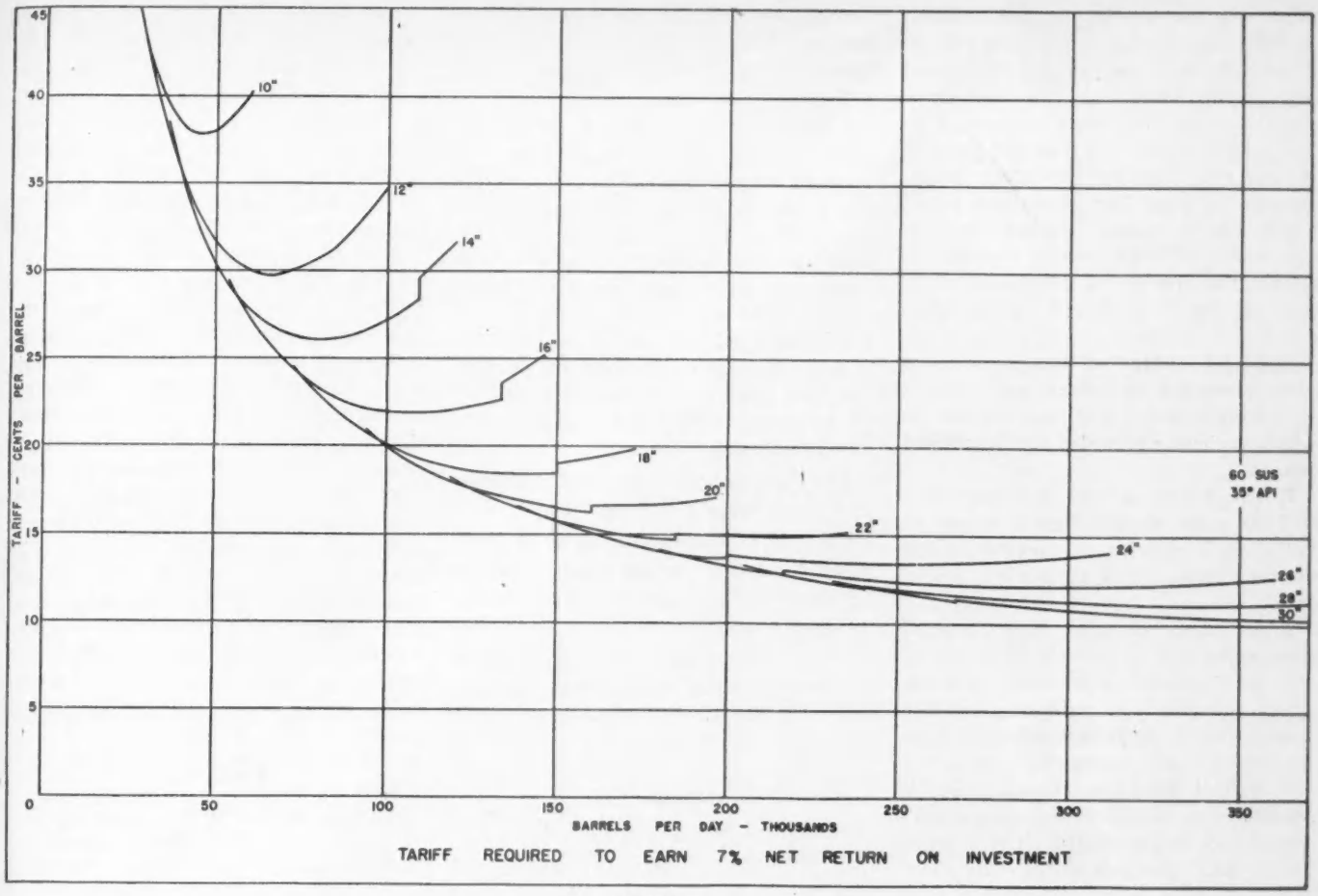


FIGURE 5

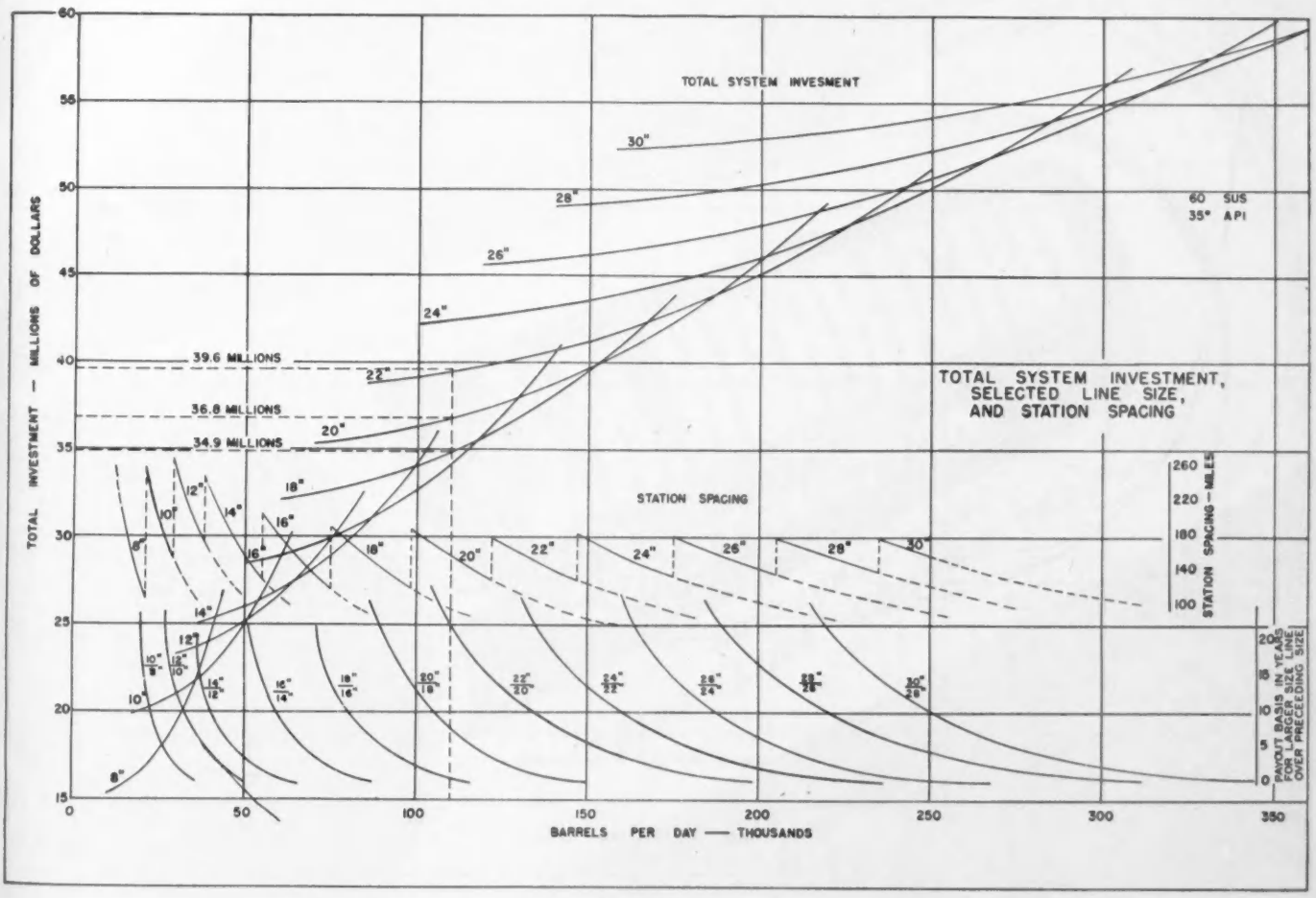


FIGURE 6

presenting the general pipe line problem in such a way that many elements of a problem may be roughly estimated even while sitting at the conference table without the delay necessary to build the estimates up from the ground. It will also demonstrate many fundamentals in pipe line economics as of today which should bracket the line size within narrower limits, thereby reducing the number of proposals necessary to be worked out in complete detail.

Since all lengths of line, all sizes of pipe, operating pressures, etc., cannot be covered completely, the manner in which each was provided for is outlined below:

1. The length of the line was fixed at 1000 miles so that figures would be fairly applicable to any length except the very short, which always is a special case.

2. All sizes of pipe were covered from eight-inch to 30-inch, inclusive.

3. Most recent construction practice, which calls for pipe walls telescoped to one-quarter inch thickness on the receiving end, was followed.

4. API-5LX46 specification pipe is considered preferable since no instances were discoverable of difficulties in welding it and the prices for this steel, having a yield point of 46,000 pounds per square inch, are not greatly different from those required for the older Grade B at 35,000 pounds per square inch yield.

5. The practice with respect to the safety factor to which the steel is stressed varies widely. "The ASA Code for Pressure Piping" calls for 85 percent of the yield point. This has been used successfully in smaller lines. Most companies laying larger lines use something like 65 percent of the yield. This study uses 85 percent for Grade B, which also corresponds to 65 percent for X-46 steel, so that these figures may be considered applicable to both these two conditions.

6. Pipe prices, freight, and construction costs were based on Oklahoma or nearby Mid-Continent areas as of June, 1948. Steel and freight have advanced about 10 percent since then. Estimates of construction costs used have proven to be a little higher than actual jobs constructed since then so that the total costs in place should be just about right for the present time.

Difficult Job

7. Operating pressures posed a particularly difficult job. By varying just the line size, operating pressure and station spacing alone an infinite number of combinations would result. One of the three had to be fixed so that the relationship between the other two could be examined as the throughput varied. Obviously neither line size nor station spacing could be fixed. If a way could be devised to show that an optimum pressure existed for each line size then that pressure could be used throughout for that line size.

The measure on which to base the optimum pressure determination is an interesting concept. The lowest operating cost will not measure it since this would ignore the excessive investment that might be required. The lowest investment would not indicate the optimum pressure since operating cost would be excessive in the cheapest system it was possible to build. The optimum pressure would set up a reasonable balance between the investment dollar and the operating dollar for the owner and deliver the transportation service to the public at the cheapest tariff rate. The fair return on the investment was selected as 7 percent which would give a payout of approximately 15 years.

Various pressures were then selected for each size of line and the tariff required to earn 7 percent was calculated as the throughput was varied by vary-

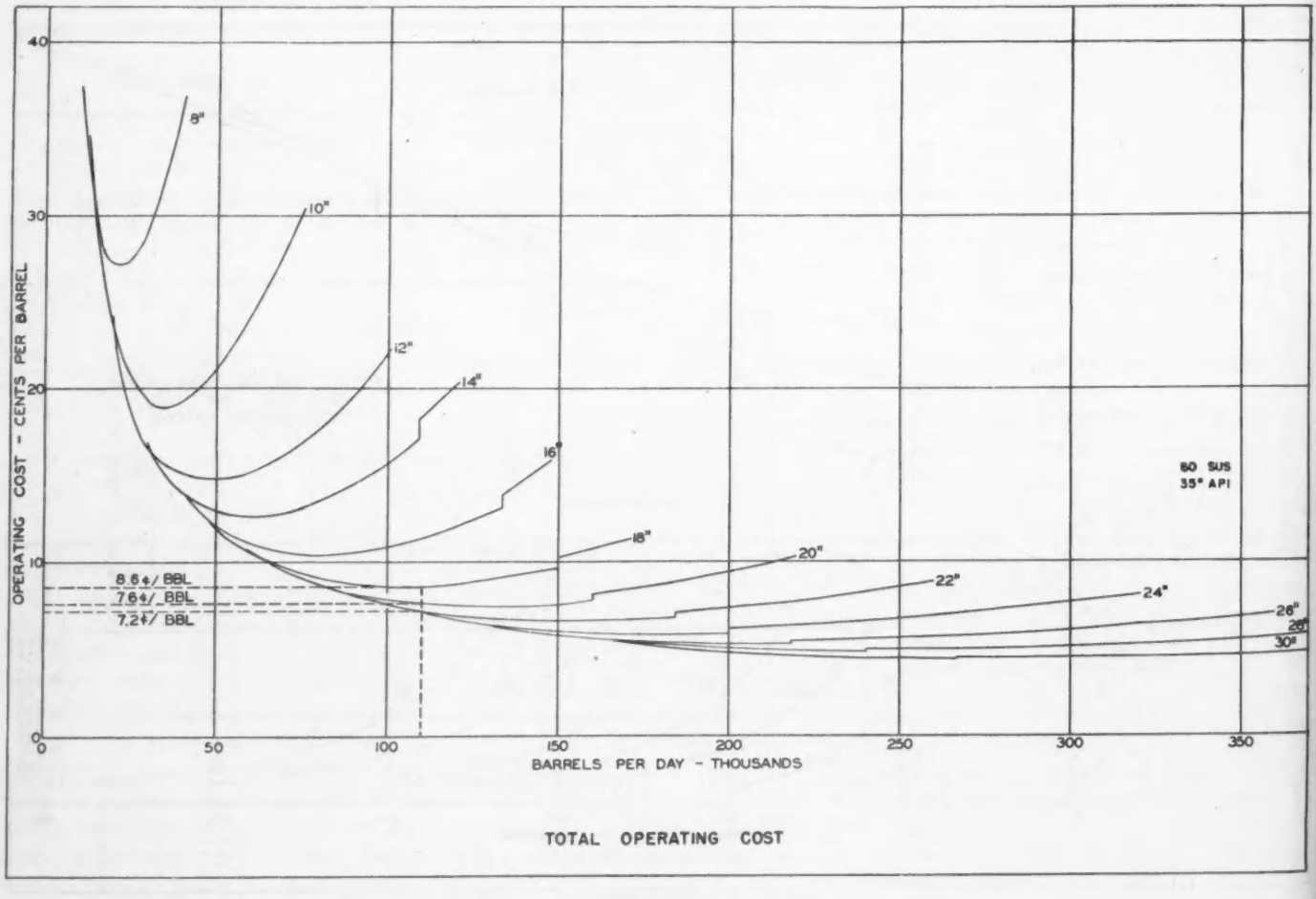
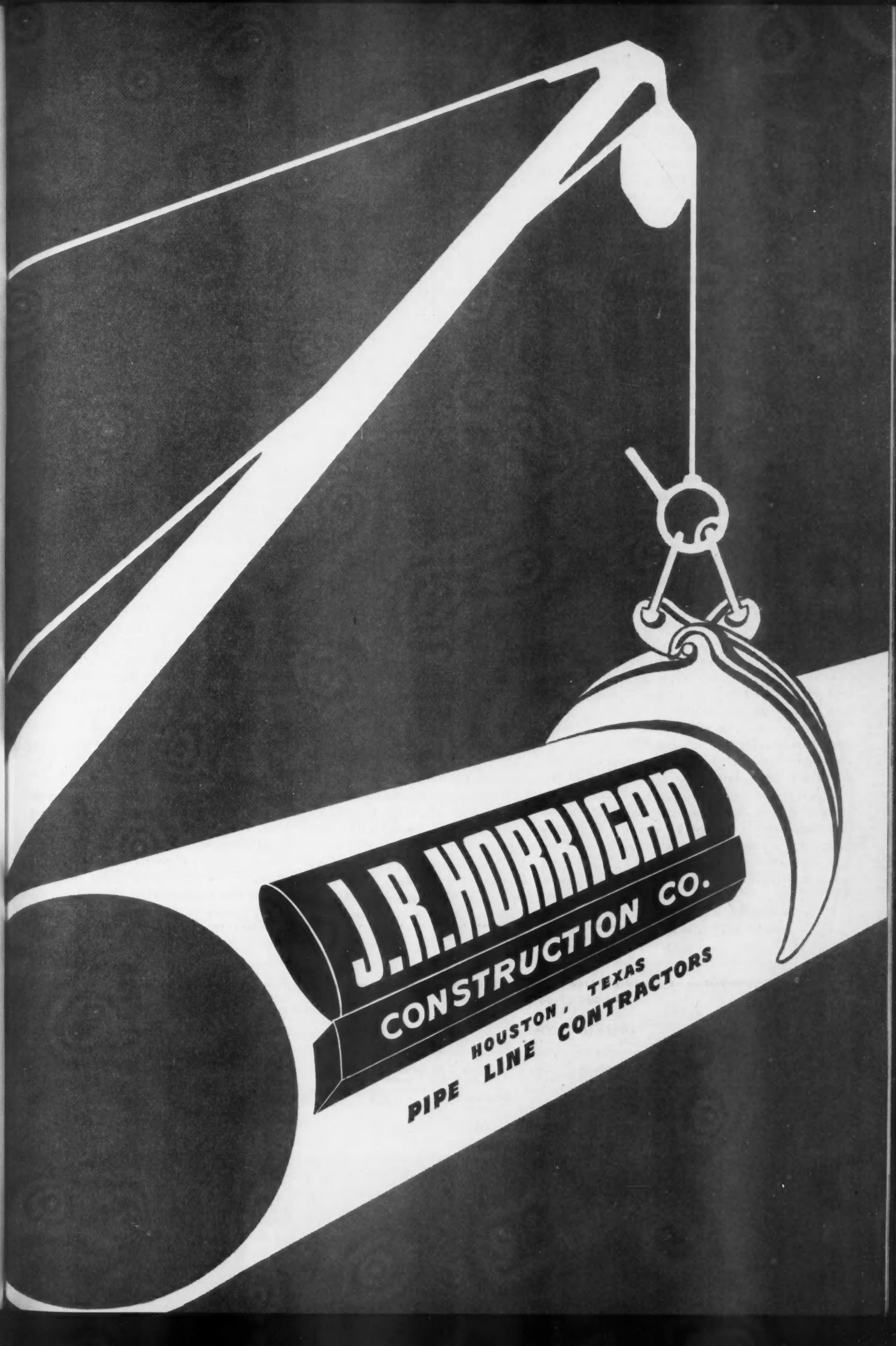


FIGURE 7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ing the station spacing. These results were plotted on a graph for each size and the tariff line which dipped the lowest indicated the pressure which was optimum for that size of pipe.

Figure 1 is a sample curve for this determination showing three pressure lines for 12-inch pipe. While it was found that an optimum pressure did exist for all sizes above eight inches, it was not sharply defined and considerable latitude on either side could be allowed with only a little variation in the tariff rate. Figure 2 shows the optimum pressure for all the sizes. It will be noted that the optimum pressure for eight inch was not indicated by the method. It proved to be too high for use with present pumping equipment.

It was discovered that, with no return to the owner (operating cost only), the optimum operating pressure increased apparently without limit with all sizes because the condition that the owners should get a fair return on investment was removed. This led to speculation as to the behavior of the optimum pressure as the rate of return to the owners might increase, shortening the payout period below the 15 years corresponding to 7 percent as would sometimes be the case. This was calculated for 12-inch pipe out to 100 percent return in one year. The results are plotted in Figure 3. It will be seen that the optimum pressure drops from 1200 pounds per square inch at 7 percent return to 1000 pounds per square inch at 100 percent return.

8. Station spacing was varied as required to provide the throughput at the optimum pressure for each size as explained immediately above.

9. Since the throughput is the basic variable it was allowed to vary throughout the range required to encompass the eight-inch to 30-inch pipe sizes.

10. Gravity of oil was fixed at a representative median level, 35 degrees API.

11. An average viscosity for the Mid-Continent area, 60 Saybolt universal seconds, was used because of the impossibility of covering the ranges encountered in this important factor. Because it affects the problem greatly, two other sets of data were calculated, at 150 sus and at 240 sus. The effect of viscosity on the tariff of a 12-inch line at 7 percent return and optimum pressure is shown in Figure 4. Similar tariff lines for all sizes were plotted on a continuous throughput base to give the rates that could be expected for any quantity read at a glance (Figure 5).

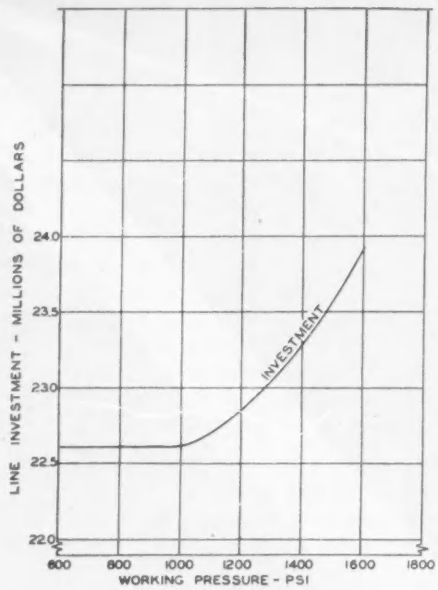

FIGURE 8. Line investment for 12-inch line.

12. Design conditions were considered to be those found in Oklahoma and vicinity.

Elevation Differences

13. Elevation differences alone can present an unlimited number of conditions so that this study was forced to ignore its effect and consider the line profile as level.

14. Operating practices considered the crew as one man on duty at a time until the station size became such that more than two 1200 horsepower units were required to be operating to handle the throughput.

15. As explained under optimum pressure determination, 7 percent was considered a fair rate of return on investment.

With these modifications of basic factors it was possible to present graphically the relationship between line size, station spacing, and throughput at the 7 percent rate of return. Also can be shown which line size would be applicable with other rates of return corresponding to payout periods up to 20 years, Figure 6.

The operating costs for the various systems can be plotted on a continuous throughput base in the same manner as the tariffs were shown, Figure 7. The manner in which the appropriate line size for a particular quantity is established is shown in Table I from readings shown in the examples shown, Figures 6 and 7. An interesting relationship with respect to minimum pipe wall thickness is illustrated in Figure 8. The optimum pressure occurs only a little above the working pressure of the minimum wall thickness and the investment bears sharply upward at this point.

The demonstration of the existence and magnitude of optimum pressure is one of the interesting developments in this study. It will be seen that the size of line that should be employed is larger than used in most earlier installations and larger than in some of the recent ones. It is also interesting that as volumes increase, a larger size line becomes more economical before the minimum tariff is reached for the preceding smaller size.

This system of analysis can be made use of by any organization using their local conditions to develop the data. It is thought that the relationship between throughput and line size may not change very greatly as prices fluctuate since construction and operation costs should move in the same direction and in fairly comparable increments.

Most pipe line economics problems presenting themselves to a company that is a going concern will involve extensions to or retirements from existing systems. This study will be of value here in visualizing the size of line to examine and the examination will be on what has come to be called an incremental basis. The cost of changes in plant will be balanced against what changes are caused in operating cost and in revenue.

TABLE 1

Example: Determination of the Proper Line Size for a 110,000 BPD Throughput of 60 SUS Crude

OPERATING COST

	Investment from Fig. 1	Cents per Bbl.	Dollars Per Year	Savings After 40% Income Tax	Payout (Years)
18".....	$34,900,000	8.6	$ 3,453,000		
20".....	36,800,000	7.6	3,051,000		
Difference.....	$ 1,900,000	1.0	$ 402,000	$241,000	7.9
20".....	$36,800,000	7.6	$ 3,051,000		
22".....	39,600,000	7.2	2,891,000		
Difference.....	$2,800,000	0.4	$ 160,000	$ 96,000	29

Since the 20" pays out in 7.9 years over the 18" and the 22" requires 29 years to pay out over the 20", the 20" line is considered to be the applicable size.

ACKNOWLEDGEMENT

Data and curves in this article were assembled by Norman E. Tilden and George G. Hughes, Jr., of the Engineering department of Interstate Oil Pipe Line Company.

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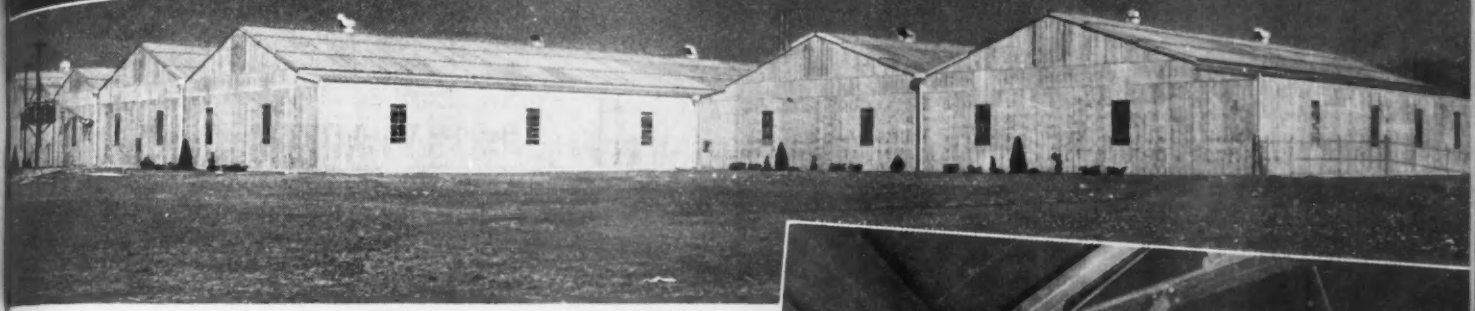

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Pipe Line Communication Systems

By F. W. LITTELL

Superintendent, Communications and Transport Facilities, Shell Pipe Line Corporation

ANY transportation system, in order to operate efficiently and economically, must utilize modern methods of communications to coordinate its various functions.

Pipe lines especially have taken full advantage of the communications art in transporting gas, crude oil and refined products. This has been done with the utmost confidence that complete information on all operating and maintenance problems can always be transmitted over their communications systems.

There are practically no records available concerning the earliest days of pipe line communication systems. We know only that the first operating orders were sent by horseback or by mail, in 1865, on the first pipe line built in this country which extended from the producing field at Pithole, Pennsylvania, to the railroad at the Miller Farm, a total distance of five miles. The riders were soon replaced by telegraphy and since most operators were railroad men they naturally followed the same procedures in which they were trained and thus the familiar "OS" for passing trains was adopted on pipe lines for gauges on oil passing the pumping stations.

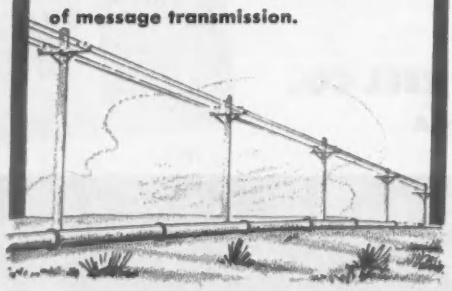
Technical advancements were made rapidly in the science and art of telegraphy, and alert pipe line managements applied these, where found beneficial, to their systems. The teletype has taken the place of the old-time brass-pounders on many of the present lines. When telephony became accepted for general use, it, too, found its place and has since become a dominant means of pipe line communications.

Most pipe line companies today have constructed and operate their own communications systems because initial discoveries of oil in this country were generally in remote areas where communications facilities such as commercial telephone and telegraph services were unavailable.

Therefore, to obtain the facilities needed, the pipe line and oil companies had to build their own. In this manner several extensive — and expensive — privately-owned telephone and telegraph systems came into existence.

After commercial services entered these hitherto remote areas it was possible to lease the required circuits. But, when additional communications channels were needed, it was much cheaper to string new wires on the existing private poles, or to derive additional circuits by superimposing various combinations of devices at the terminals and pump stations on existing wires. Voice repeaters became available for private usage. Thus the usable range of voice transmission was extended allowing intelligible conversation over long distances. Carrier systems were perfected. Several telephone or telegraph channels can be made available over one pair of wires by the use of different frequencies for each channel. The operation of a carrier-current system is very much like a home radio. By tuning to various frequencies it is possible to listen to different stations without interference from other stations—if the set is properly aligned. Often two or more stations can be heard at the same point on the dial; or other conversations can be heard on a privately-owned carrier circuit. This is called cross-talk and demands a diagnosis by the wire-chief and appropriate treatment to remove the cause.

THE AUTHOR summarizes present methods of communication, and outlines a system which would be able to handle all demands of a long line through inaccessible areas. The future communication system is seen to utilize very high frequency radio, and to be independent of existing means of message transmission.



Often overlooked is another important point in favor of private ownership. Most pipe line communication systems are constructed on the same right-of-way as the pipe line itself. This makes it possible for maintenance crews, or any other personnel, to keep in telephone contact with headquarters merely by attaching a portable telephone to the line wires. While leased service may reach all the stations on the pipe line, its devious routing prevents it from fulfilling this simple requirement which is most important when a line breaks, and down-time reduces the throughput, not to mention the income.

Through the years pipe line engineers have kept abreast of rapid developments

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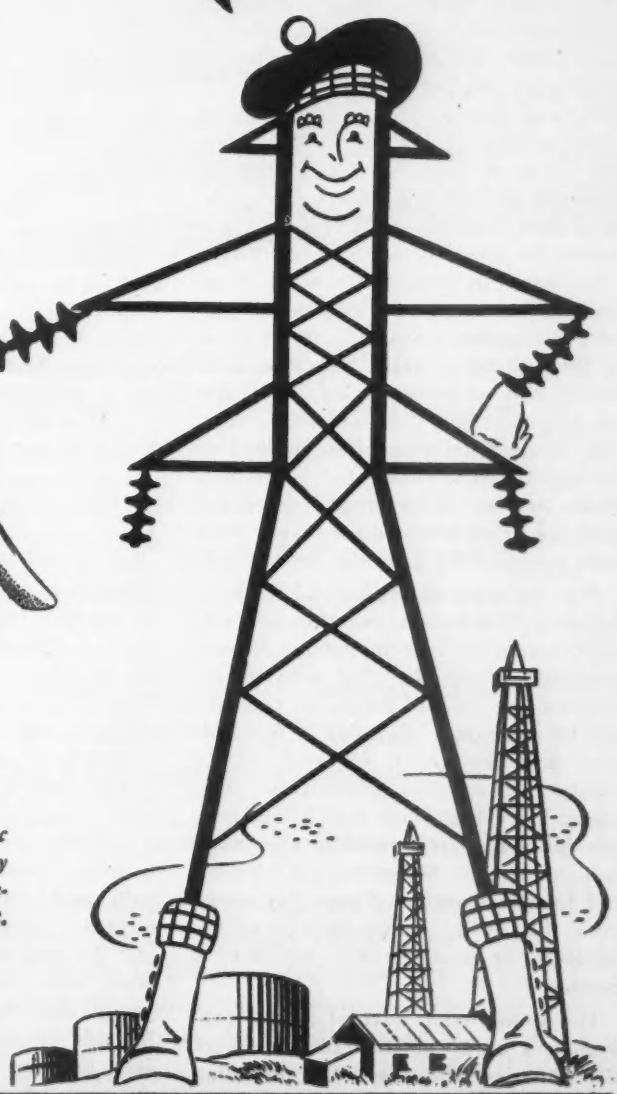

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in communications so that most pipe line companies now can boast, with justifiable pride, that their communication systems embody the latest methods and finest equipment available.

Latest advances include the application of frequency-modulated radio, which is rapidly coming into widespread use in private communication systems.

The petroleum industry has used radio for about 25 years in geophysical exploration work. However, the radio needs in other operations, such as pipe lines, could not so readily be served because of restrictions on frequency allocations, the demand for which has greatly exceeded the number of channels available in the frequency spectrum.

Just prior to the last war, radio engineers had developed the practical use of the higher frequencies, thereby making possible broader use of the spectrum. Wartime research developed many new circuits, tubes and techniques that permit a multitude of new applications at these higher frequencies. But, before these could be fully utilized, standards had to be formulated for the existing radio services as well as the new ones, and frequency allocations had to be rearranged among the various classifications of radio services. This job was started by the Federal Communications Commission in 1942. While much progress has been made the situation is still far from satisfactory and there are those in the industry who feel that FCC should, without further delay, implement the full launching of these mobile services. Some relief was afforded in 1946 through the establishment of the Utility Radio Service which opened some frequencies to pipe lines on a shared basis with public-utility power companies.

A group of pipeliners in the Petroleum Industry Electrical Association, which is composed of the superintendents of communications and electrical departments representing most of the major pipe line and oil companies operating in the Midwest and Southwest, objected to the scanty recognition given their radio needs. They filed with the FCC a petition for the establishment of a separate radio service for the petroleum industry and for the transfer of pipe line usage from the Utility Radio Service to the newly proposed Petroleum Radio Service.

The Commission advised it was conducting a study of the radio needs of all industries with a view to providing a new "Industrial Radio Service" under which improved services would be available to the petroleum industry.

Since then, the PIEA Committee and a new committee, the Central Committee on Radio Facilities of the American Petroleum Institute, have been actively assisting the FCC in the preparation of the proposed new rules and regulations for the "Petroleum Radio Service."

Continuity of service is, of course, one of the greatest advantages offered by the use of radio. Ice doesn't collect on radio waves as it does on wire lines. In addition to voice and teletype channels for dispatching and regular operations, some of the new services include intercommunication between pipe line patrol planes and pump stations, between repair gangs or construction crews, and between gaugers making complicated valve changes in large tank farms. Radio will be available also to remote control motors at isolated tank batteries in gathering systems, and for telemetering which can be used for automatic transmission of pressures and of the readings of remote instruments. No doubt it will serve other jobs which pipeliners' ingenuity will bring forth.

Anything that can be done over a wire line can be handled just as well by the use of radio. Frequency modulation is essentially of short range and limited to line-of-sight transmission, but the use of repeater stations can extend the range indefinitely.

Isolated Line

To better visualize what can be done with radio when we are not restricted, consider the communications requirements of an isolated pipe line, for example in the Middle East, extending about 800 miles from the Persian Gulf to the Mediterranean Sea. Much of the terrain is desert, some of it mountainous. There are no towns or sources of material or food supplies in the interior where the pump stations will be located. A self-administered community must be set up at each station, to be supplied by truck or airplane. While trucking across the desert is feasible, probably most of the travel will be by plane. The supply planes may possibly also patrol the pipe lines; in any event the line will be patrolled by plane.

The very nature of the terrain precludes the construction of a pole line. Therefore, the use of radio is indicated to communicate between terminals, and with each station. The terminals will want to communicate with tankers at sea, the aircraft with terminals and stations, the stations with maintenance gangs, and the gangs with each other. All this will require several radio channels. Perhaps also will be wanted telemetering, teletype or "facsimile" circuits. Because each location will have dispensaries, commissaries, churches, schools, recreational facilities, etc., a dial telephone exchange will be needed at each terminal and pump station. Now that we know the requirements, let's see what can be done.

Since we need so many circuits let's use wide-band frequency-modulated very-high frequencies because VHF is unlikely to cause or suffer from radio or other forms of interference. The VHF band is between 30,000 and 300,000 kilocycles. On the VHF we will employ multi-channel voice carrier technique. By using VHF we will require several repeater or relay stations along the line because of the "line of sight" limitations. To further minimize the possibility of interference, we will use directional antenna arrays, which will result in "narrow-casting" the radio waves instead of broadcasting. By such arrangements, we can obtain seven voice-frequency channels in each direction, six being used for speech circuits and the seventh providing six teleprinter and six dialing circuits as well as a number for remote telemetering along the pipe line.

Integrated with the VHF chain we will install a high frequency radio system (in the frequency band between 3000 and 30,000 kilocycles) at the terminal and intermediate stations principally for communication with aircraft. At the two coastal terminals, these sets can provide a radio link with oil tankers at sea. For end-to-end communications, we would provide, at the terminals only, an HF system employing one speech and one teleprinter channel in each direction for administrative purposes.

At the automatic telephone exchanges, certain telephones could be arranged to dial direct into one of the radio voice channels and select a telephone at any of the other exchanges. By practically the same arrangement, the teleprinter circuits should also be fully automatic so that a machine at any location may be selected from any other location.

Readings of certain pre-determined meters associated with the pipe line itself may be collected from every station and displayed at all stations continuously and automatically.

Low-power VHF mobile sets would certainly be installed in vehicles of maintenance crews and the members of the crews would be furnished with pack sets.

The above hypothetical installation envisages the ultimate which has been achieved to date in pipe line communications. Its general application is anticipated and may be surpassed since the pipe line industry is noted for its progressiveness. It is not too much to predict that when the satisfaction over the efficiency of such a layout has subsided some pipeliner may well question management as to why it has not as yet installed television. One point is certain —when television or any other technique has been developed which will improve pipe line communications the pipe line industry will certainly adopt it.

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Packaged Unit Sub-Stations

THE AUTHOR describes and illustrates simplified transformer and control units which reduce station tie-ins to a minimum and insure proper distribution of power. Types of transformers adapted to this service are also evaluated.

INCREASED use of electrical energy in pipe line operations plus the fact that energy distribution costs represent more than 50 percent of the total cost of an electrical system behoove electrical and pipe line engineers to study all means for cutting down costs and achieving greater operating efficiency. In this respect a study of pipe line unit sub-station equipment merits serious consideration.

The primary voltage for supplying pumping stations usually ranges from 13.2 KV to 66 KV, three-phase, 60 cycle. Of course, it is necessary to step these voltages down to usable operating voltage. At this point the factory built unit sub-station or "packaged" unit sub-station offers a safe and economical method of solving this problem.

Open type construction usually requires separate enclosures for control panels. Various parts such as circuit breakers, instrument transformers, disconnect switches, etc., are connected together by bare conductors which do not provide the safety offered in a metal enclosed unit sub-station. Usually a station using open type construction requires more engineering on the part of the purchaser.

The factory-built unit sub-station with its coordinated parts consisting chiefly of a main step-down transformer and metal clad switchgear equipment was widely used during the war. This type of equipment has been standardized, making it possible to purchase complete equipment from one manufacturer who does all the engineering work and supplies all the materials. The only remaining work to be done by the user would be to pour the foundations and make primary and secondary connections.

There has been a definite trend towards three-phase transformers due to the improvement in this type of equipment. This type of transformer simplifies the unit sub design making the coordination between the transformer and switchgear an easy matter, and also providing simplicity together with other features which will be described herein.

It is difficult to say just when the first unit sub-stations were built. However, the idea quickly took hold and at the present time it is an accepted and proven class of equipment.

There are a number of various types of unit sub-stations and they vary in size depending upon the amount of load. They can be arranged so that additions can readily be made as the load grows. The type mostly used by the petroleum industry is the multi-circuit type. There are several arrangements of this type such as "Radial" or single ended unit having one transformer together with its metal enclosed feeders (Figure 1).

This type of unit has the advantage of simplicity and low cost. The disadvantage is that its reliability depends upon one power supply.

Where it is desirable to have a standby transformer or two sources of power the double ended unit or "Secondary Selective" unit can be used (Figure 2). This arrangement makes it possible for one transformer to be taken out of service. The remaining transformer would then carry the load. Forced air cooling is usually provided to meet this condition.

One interesting application of a unit sub-station is shown in Figure 3.

This arrangement was designed for a pipe line and is of outdoor construction. This line has a considerable number of sub-stations of widely varying primary voltages ranging from 13.2 KV to 66 KV. The main transformer is for stepping the voltage down to 2400 volts. To the secondary side of the transformer is connected the metal-clad switchgear which consists essentially of power companies' metering compartment, also an auxiliary compartment in which are mounted a control transformer together with tripping battery and charger. The control transformer is used for closing the circuit breaker electrically, also for battery charging together with supplying energy to voltage relays on motor switchgear units. The units are arranged for full voltage starting of induction type motors. Fused capacitors are mounted within the units for power factor improvements.

There is also provided a station service transformer to further step down the voltage to 440. This is for lights, small motors, etc. Provision is made for future expansion.

The outdoor motor switchgear units are operated from a control desk located in a separate building. In this building are also housed the pump motors. This arrangement minimizes the amount of electrical equipment in a pumping sta-

By
V. G. MURDOCK
Allis-Chalmers Manufacturing Company

tion, thereby cutting the building costs and operating hazard.

Some stations are arranged with switchgear together with motors and control located in the same building as the pumps. The building with this arrangement is divided in two by a partition; the switchgear and motors being located in one section and the pump in the other. The operating shaft for the pumps extends through the partition.

It might be well to consider briefly another type of unit sub-station—the load center type. This type is for distributing power at the lower voltages, such as 440 and below.

In the past where low voltage was used it was common practice to step the voltage down at one point for all parts of a plant. The power would be distributed by means of long heavy cable runs, which not only were costly to install but also expensive to operate due to cable losses.

The modern way to distribute power at lower voltages is to place unit sub-stations in close proximity to the load, thereby avoiding long heavy cable runs. This type of system also provides better regulation.

Load center unit sub-stations can be of indoor or outdoor construction.

Transformers can be oil filled (usually for outdoor), non-inflammable liquid filled or dry type. There are certain advantages and disadvantages for each type and consideration should be given to these features. Oil filled transformers, while widely used outdoors, require a vault when placed indoors. Non-inflammable liquid filled units require a minimum space which is approximately the same as oil. Head room to remove the core and coils from the tank for inspection, etc., is necessary. Dry type transformers, of course, eliminate all liquid and provide ease of inspection of the windings and are comparatively light in weight. The space requirements are, however, somewhat greater than for liquid filled units.

The inherent design of factory built metal enclosed unit sub-stations provides a high insulation factor of all electric conductors; interlocks are also a part of the designs to provide the maximum in safety.

Installation time and expense are kept to a minimum. As a system grows units can be easily added. Systems using unit sub-stations are usually so arranged that interrupting capacities of circuit breakers are fixed and no further consideration need be given to this point.

The salvage value is high as the units can be transferred economically to other locations.

With these advantages the unit sub-station offers a means of meeting changing conditions in pipe line operation.

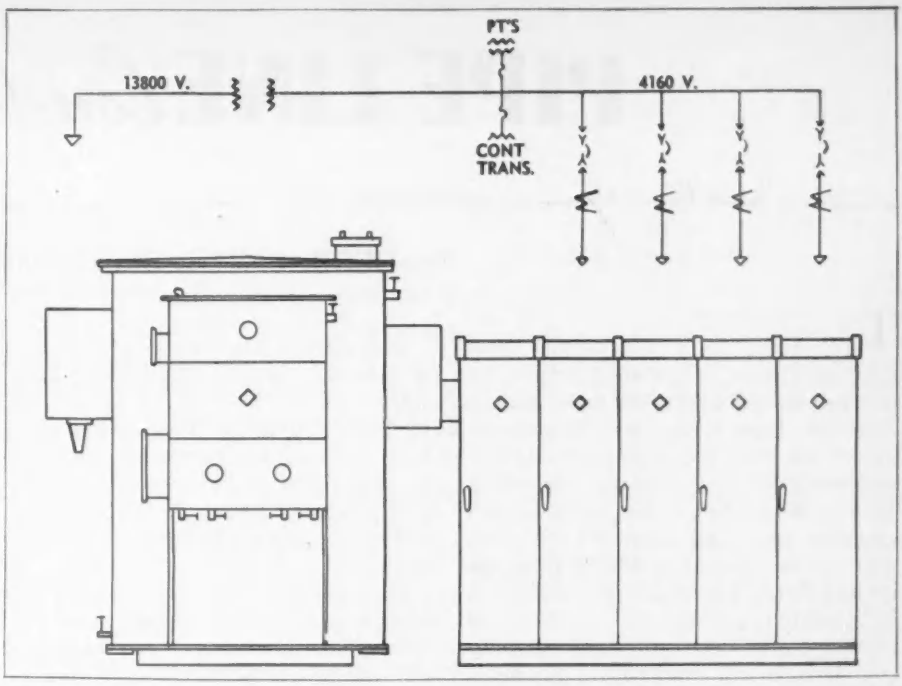


FIGURE 1. Multi-circuit type unit sub-station for radial service having single transformer at left and switch and distribution panels at right. Reliability is dependent upon single power supply.

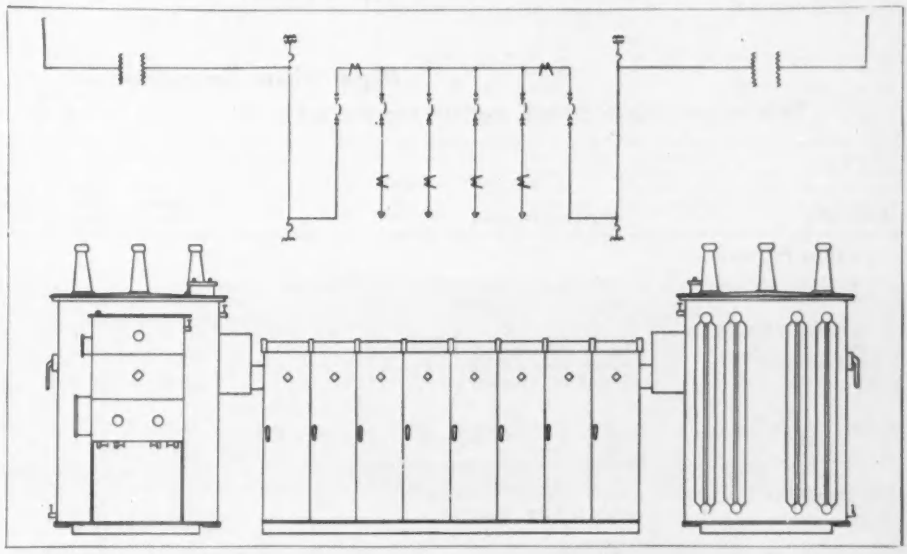


FIGURE 2. Double-ended unit sub-station with incoming service from two sources to dual transformers with no tie breaker. This setup allows one transformer to be withdrawn from service without affecting station operation.

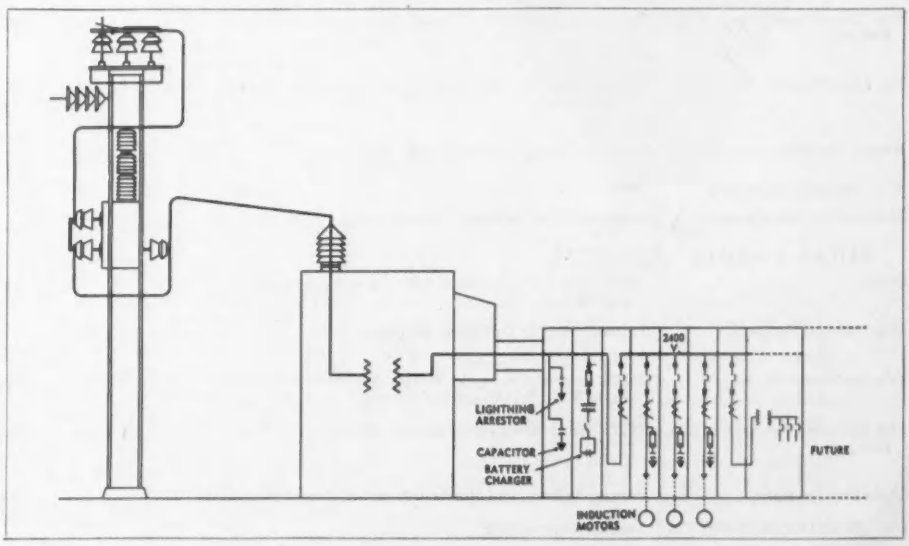
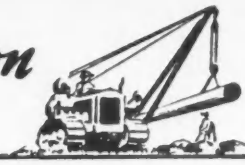


FIGURE 3. Radial-type unit sub-station with steel structure for dead ending incoming lines. Switchgear portion has built-in capacitors for power factor correction, also dry type power transformer for station service.

PIPE LINE *Construction*



By CECIL SMITH, Staff Writer

TWO major natural gas pipe lines that have been in planning stages for many months are now well under way.

Actual pipe laying on Transcontinental Gas Pipe Line Company's Texas-to-New York City line was started at Laurel, Mississippi, and is being pushed eastward from that point. At the same time the line was started back from the initial point to Louisiana, where gas will be supplied when the line is completed to New York. When the system is fully completed it will extend from gas fields near the Texas and Mexico border to the Hudson River at New York City.

Construction plans for the remainder of this year call for the laying of 605 miles from Eunice, La., to Athens, Ga. In 1950 the line will be extended to New York and will be put into operation by September of that year. Completion to the Texas Rio Grande Valley in 1951 will make this pipe line the longest ever built.

This 1840-mile transmission line has been designed for an initial capacity of 340 million cubic feet of gas a day and will cost about $190 million. However, the delivery rate can be stepped up to 505 million a day by additional compressor stations, which would raise the cost to $235 million.

The 800-mile trunk line of Texas Gas Transmission Corporation is well under way with all contractors already at work on their spreads or preparing to start immediately. This line will originate in the Carthage and Lisbon gas fields of East Texas and Louisiana and will run through the Mississippi and Ohio River Valleys to a connection with the Big Inch system of The Texas Eastern Transmission Corporation near Middleton, Ohio.

Pipe Line Construction

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Continental Oil Company	Buck Creek field to Lance Creek field, Niobrara Co., Wyoming. Main line and gathering system	18	3 to 8	.....	Work in progress by C. P. Bartley & Son, Lance Creek, Wyo.
The Cooperative Refinery Association	Plainville to Phillipsburg, Kansas	45	4 & 6	.....	W. E. Bolt Construction Co., Jenks, Okla. has work underway.
Gulf Oil Corporation	Delaware River and International Airport to 84th Street Tank Farm, Philadelphia	17	10-12-24	.....	John Meehan & Son, Phila., expects to complete by September.
Magnolia Pipe Line Company	North Snyder field, Scurry Co. to Iatan Station, Howard Co., W. Texas	39½	6 & 8	28,000	C. L. Rogers Construction Co., Wichita Falls, began work in May and estimated completion in late June.
	Lateral line and field gathering system	30	3 & 4	.....	
Mid-Continent Pipe Line Company	Mounds to Sapulpa, Oklahoma	10	10	40,000	Job started in June by C. P. Carter Construction Co., Duncan, Okla. and will include take up of 8-inch line, between Mounds and Sapulpa.
	Sapulpa to Tulsa, Oklahoma	9	8	.....	
Shell Pipe Line Corp. and The Texas Pipe Line Co. (Ozark Pipe Line System)	Cushing to Chelsea, Okla. Sect. 1 of Cushing to Wood River, Illinois, line	79	22	187,000	Laying of this section which included crossings of Arkansas and Cimarron Rivers was completed June 1, by Midwestern Constructors, Inc., Tulsa. Midwestern is now installing units and pipe facilities at five pump stations along line.
The Texas-Empire Pipe Line Company	Bethany to Gibson City, Illinois	61½	18	69,000	This is Sect. 2 of the Patoka to Wilmington, Ill., line. H C. Price Company, Bartlesville, Okla., averaged 2 miles a day to complete this line well ahead of schedule.
The Texas Pipe Line Company	Pickett Ridge field ,Wharton Co., to Withers Sta., Upper Texas Coast	13¼	8 & 10	.....	Associated Pipe Line Contractors, Inc. (Formerly Associated Contractors & Engineers, Inc.) of Houston have completed this line.
Warren Petroleum Company	Gathering system near Maysville, Oklahoma	29	2 to 26	.....	Job underway by Holland Construction Co., Tulsa.
PRODUCTS LINES					
Buckeye Pipe Line Company	Lawrenceville to Robinson, Illinois	21	6	.....	Scheduled to start July 1 by H. L. Gentry Construction Co., Jackson, Mich.
NATURAL GAS LINES					
County Gas Company	TETCO Big Inch near Perth Amboy to company's system near Keyport, N. J.	11½	6	3 mln	FPC authority granted. Cost of project estimated to be $280,000.
Dow Chemical Company	Pentwater field to Ludington, Michigan	11	8	.....	Completed in June by Somerville Construction Co., Ada, Mich.
Erie Gas Service Co., Inc.	TGT's proposed Kentucky-Buffalo line near Meadville, Pa. to Wickliffe, Ohio, east of Cleveland	72	.....	26 mln	Application made to FPC. Line would supply gas to utilities serving 7 communities east of Cleveland.
East Tennessee Natural Gas Company	TGT's line at Greenbriar, Tenn. to AEC plant, Oak Ridge	172	22	60 mln	Work being done jointly by Oman Const. Co., Nashville; R. H. Fulton & Co., Lubbock; and Brodie Const. Co., Amarillo. November 15 is scheduled completion date.
Home Gas Company	Orange, Sullivan, and Rockland Counties, New York	52	.....	35 mln	FPC approval has been granted.
Iowa-Illinois Gas and Electric Co.	Near Davenport, Iowa	11	10	.....	Midwestern Contractors, Inc., Chicago, are scheduled to complete June 30.
Iroquois Gas Corporation	Hamburg to Langford, New York	8	22	.....	H. L. Gentry Const. Co. has work under way.

Pipe Line Construction—(Continued)

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
Panhandle Eastern Pipe Line Company.	Looping between Liberal and Emporia, Kans. on Texas-Michigan line.	114	26	.....	Entire contract completed in May by R. H. Fulton & Co.
	Additional looping in Kans. on same line	74½	26	.....	Started in June by same contractor.
The Peoples Natural Gas Company	TETCO line northeast of Rockwood, Pa. to company's line northeast of Johnstown, Pa.	38	14	.....	Williams-Austin Co., Coudersport, Pa., began in June and will complete October 1.
Regie Autonome des Petroles	Toulouse to Bordeaux, France	149	8	35 mln	This line was started in 1948 and is now completed.
San Diego Gas & Electric Company	From end of Southern Counties Gas' line at Rainbow to Mission Valley, San Diego Co., California	50	16	40 mln	Part of 85-mile project from Texas-to-Cal. line to San Diego. Section is underway by Utility Const. Co., and N. P. Van Valkenburgh Co., South Gate, Cal.
Southern Counties Gas Company of California	From Texas-to-Cal. line at Moreno to San Diego Gas' line at Rainbow, California	35	16	40 mln	Remainder of above 85-mile project. FPC approva but contract not yet let.
Stanolind Oil & Gas Company	Gathering system in Levelland field, Hockley Co., W. Tex.	126	2 to 30	.....	This line will gather for the company's gasoline plant in the field. Deaton & Sons, Inc., Odessa, Tex. is doing the constructing.
Texas Gas Transmission Corporation	East Texas to Middletown, Ohio	723 110	26 20	304 mln	The following contractors have spreads now working: N. A. Saigh Co., 110 mi 20-in. Carthage to Lisbon, La.; Latex Const. Co., 101 mi Lisbon to Miss. River; O. C. Whitaker Co., 86 mi Miss. River to Lula, Miss; Horrigan Const. Co., 110 mi Memphis to Fulton, Ky.; Oklahoma Const. Co., 103 mi Fulton to Slaughters; Williams Bros. Corp., 166 mi Slaughters to Ohio River; Midwestern Const., Inc., 80 mi Ohio River to Middletown.
Transcontinental Gas Pipe Line Co.	S. W. Texas to New York City	1840	20-26-30	340 mln	Contractors now at work on this project are: Morrison Const. Co., Inc., 180 mi. Eunice, La. to Bassfield, Miss; Wunderlich & Griffis P. L. Const. Co., 112 mi Bassfield to Tombigbee River, Ala.; Midwestern Const. Inc., 216 mi Demopolis, Ala. to Newnan, Ga.; Williams Bros. Corp. will lay 110 miles in Ga.
United Gas Pipe Line Company	Baxterville field, Lamar Co., Miss. to Mobile Jct. Ala.	70	20	100 mln	O. C. Whitaker Co., Ft. Worth, is schedule to begin laying main line by end of June.
	Gathering system in Baxterville field	9½	.....	.....	
U. S. Atomic Energy Commission	Existing gas line 35 miles south of Bloomfield to Los Alamos, New Mexico	95	12	.....	Morrison Const. Co., Inc., Austin, has begun work on its 43-mile section and Haddock Engineers & Associates, Ltd., Santa Fe, has its 52 miles underway.
Westcoast Transmission Company, Ltd.	Northern part of Province of Alberta, Canada, to Northern California	1400	30	500 mln	This line is now being planned. Westcoast is a newly formed concern for construction and operation of the Canadian part of line. An American firm would be formed for the U. S. part. Estimate cost of project is $175 million.

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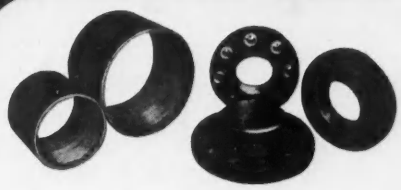

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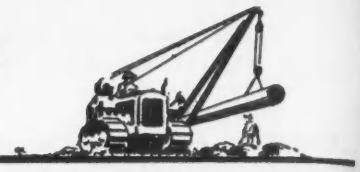
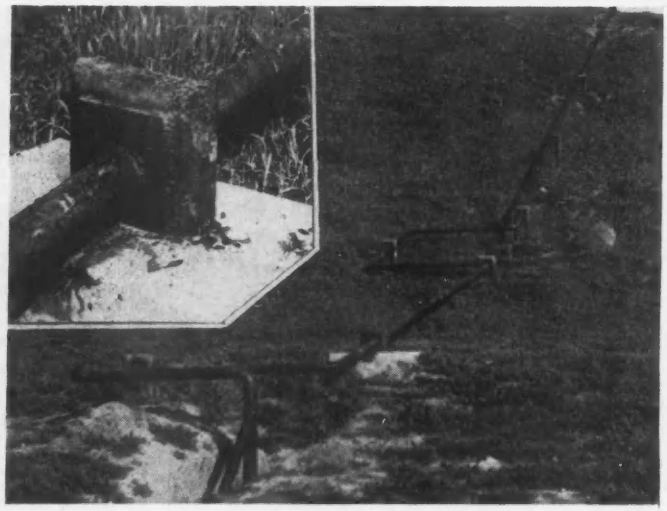
How to do it!

PIPE LINE HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Anchor and Support Raised Gas Lines



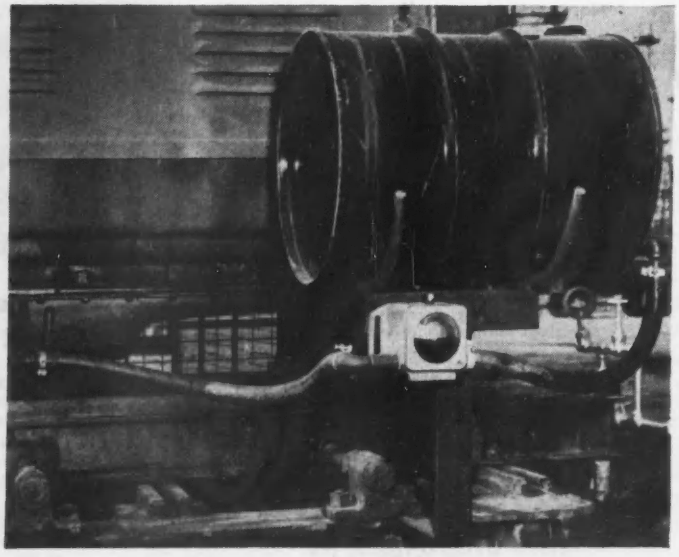
On extremely high-pressure natural gas lines, in the order of 2500 pounds per square inch, it is essential that adequate compensation be provided for expansion and contraction of the line to prevent breaks. Additional precautions must be taken where the line is carried above ground and subject to greater extremes in temperature variations.

In the situation illustrated, a four-inch, high-pressure gas line was supported above ground to facilitate inspection and repair. Expansion loops were made into the line at intervals to absorb the expansion and contraction due to changes in temperature. At the lower left of the illustration, the line goes below ground for a highway crossing. An expansion loop was added at this point to prevent any break in the right-angle bends. Note the 45-degree bracing on the line leading into the ditch.

The line was firmly anchored between the two expansion loops shown. This anchor prevents creep down hill that would place excessive stress on the right-angle bends as the line goes under the highway. This anchor was made by forming a U-shape from pieces of four-inch line and covering the open sides with heavy steel plate. Holes were cut for the line and the assembly welded to the line. The bottom legs were set in a heavy concrete form. The anchor is shown in the inset.

Regular supports placed at regular intervals along the line are made from left over four-inch pipe. Two short sections are driven in the ground on opposite sides of the line and a cross piece welded on top. A cross piece is welded below the line to take all the weight. Such a support permits free movement of the line longitudinally, but controls lateral movement.

HOW TO—Maintain Oil Level in Pump Engines



Transferring oil from several isolated tank batteries into the pipe line requires a special pump to handle the volumes and pressures necessary. In such areas, the pumps are driven by gasoline or diesel engines, usually of relatively small horsepower. When these engines are required to operate over long periods under heavy loading, it is important that the oil in the crank case of the engine be maintained at the proper level to insure lubrication of moving parts.

The device illustrated was installed on such an engine, not only to insure adequate lubrication, but to reduce the job of engine maintenance. Enough lubricating oil to last several months can be stored in the drum shown. The drum is mounted in a cradle made from three-fourths-inch sucker rod material curved to the contour of the drum. A horizontal steel beam supports the cradle, and the complete unit is bolted to the engine foundation skid.

Oil is taken from the drum through a gravity line connected near the bottom and at one end of the drum. Neoprene rubber hose is used to carry the oil from the drum to an oil level regulating device. Oil is further carried from the regulating device to the crankcase. Should the level in the crankcase drop below a predetermined point, the regulator opens to permit additional oil to flow from the drum reservoir. A view port in the level regulator permits the pumper to check the operation of the controller.

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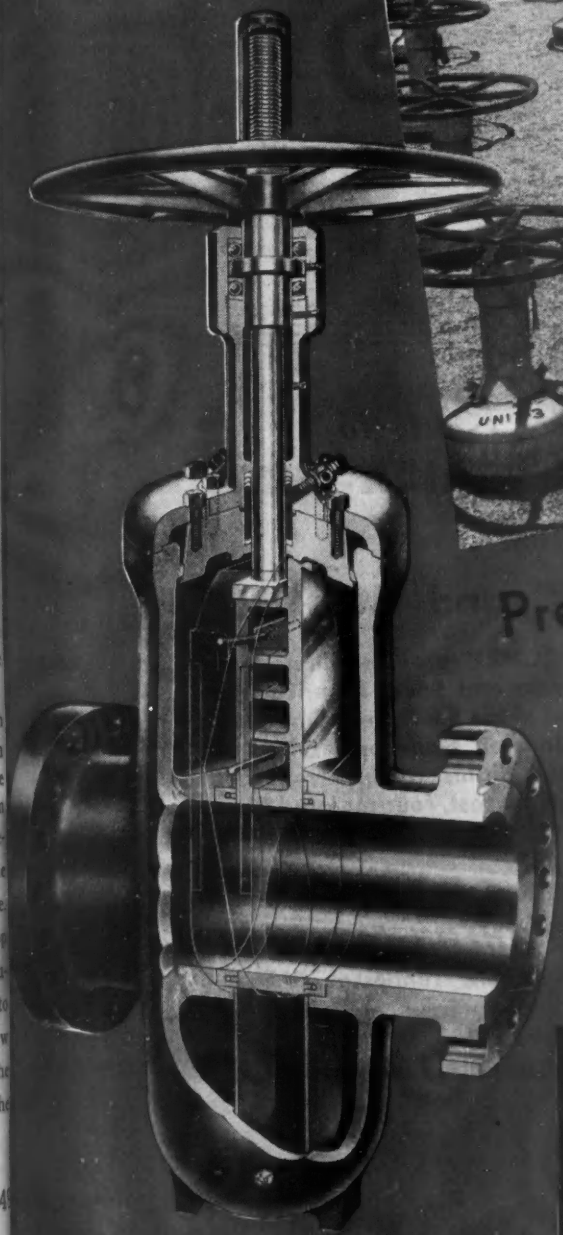

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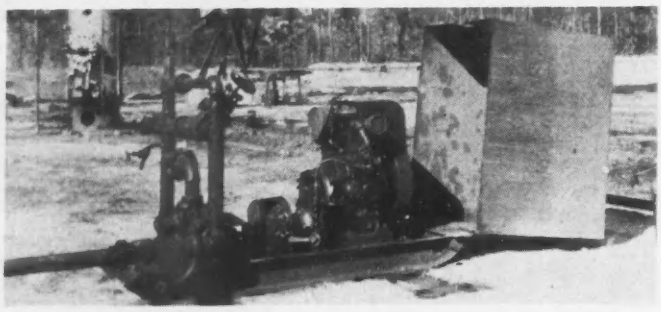
HOW TO—Protect Small Pipe Line Pumps in Bad Weather



Where small pumping units are set out on leases to pump out individual tank batteries, small pumping units are usually employed. They are too small to justify a building for shelter, yet the internal combustion engine requires protection from the weather. One pipe line company uses over the engine a hinged cover which lays back when the engine is in service, yet can be turned over so as to cover the engine completely when not in use.

It is composed of small gauge steel welded into a box shape with only a small opening cut out to make space for the pump coupling when the hood is lowered. Hinges on either side are welded to the skid and to the inside of the box. A hasp and lock are provided so that the cover can be locked down when the pump is not in service. When the pump is running, the building is practically removed so that sufficient cooling is provided the engine.

HOW TO—Reduce Noise of Pumps Near Residential Areas

When gas engine-driven pumps are operated near communities, a pipe line company will try to muffle all sounds as much as possible. One company which operates in a suburban area does not depend upon a conventional single muffler to deaden the sound of engine exhaust, but installs two in series so that the noise from the last tail pipe can be heard only a few feet away.

The first, and more conventional, muffler is mounted directly upon the engine manifold in a horizontal position with a bracket supporting the tail pipe end of the muffler. This tail pipe terminates

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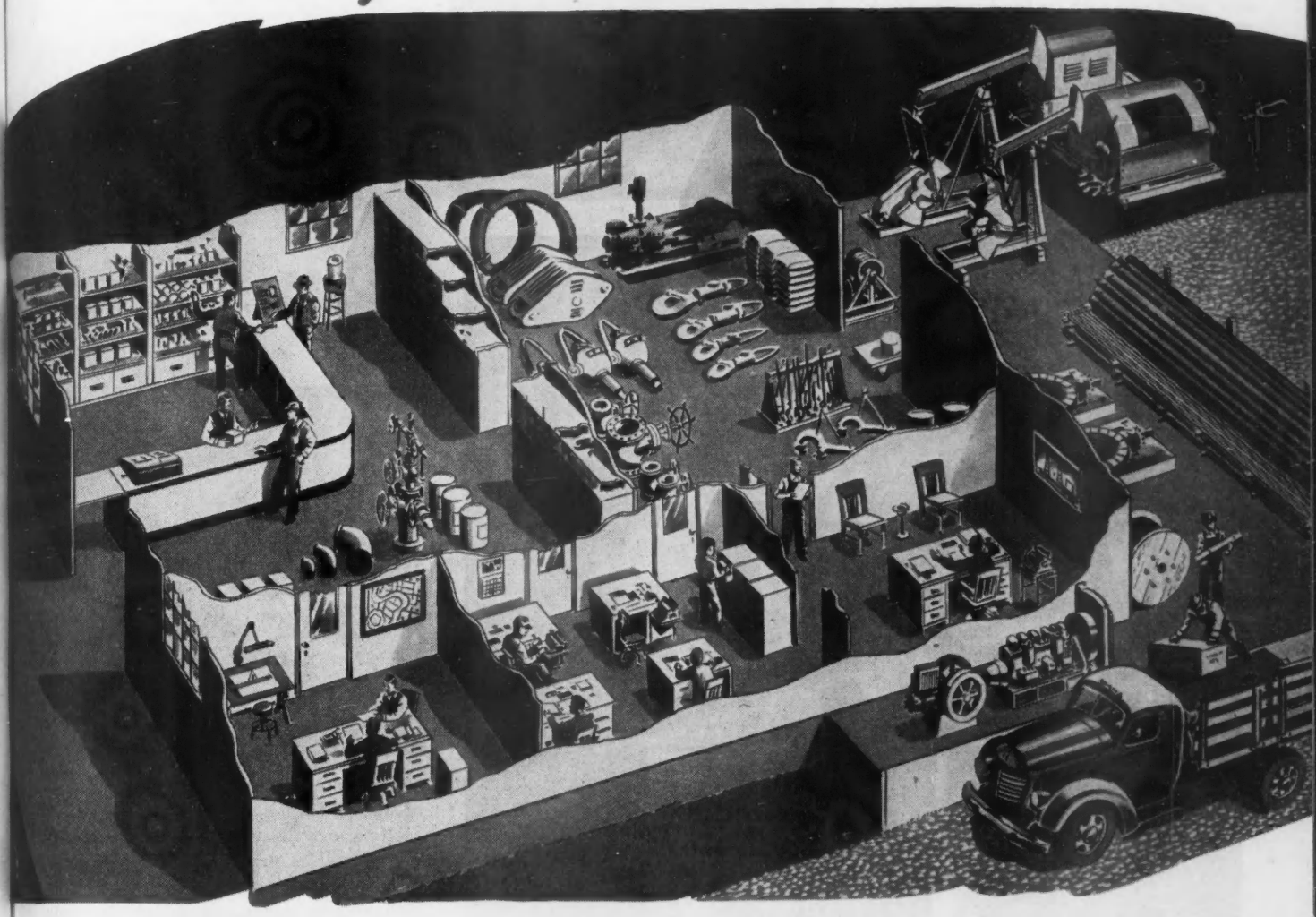

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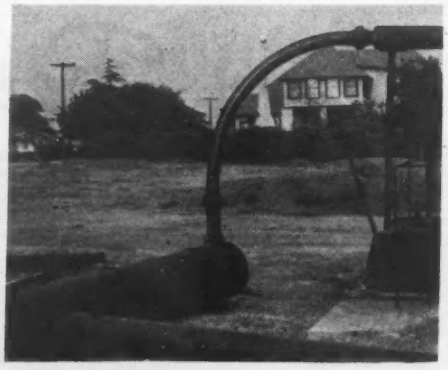
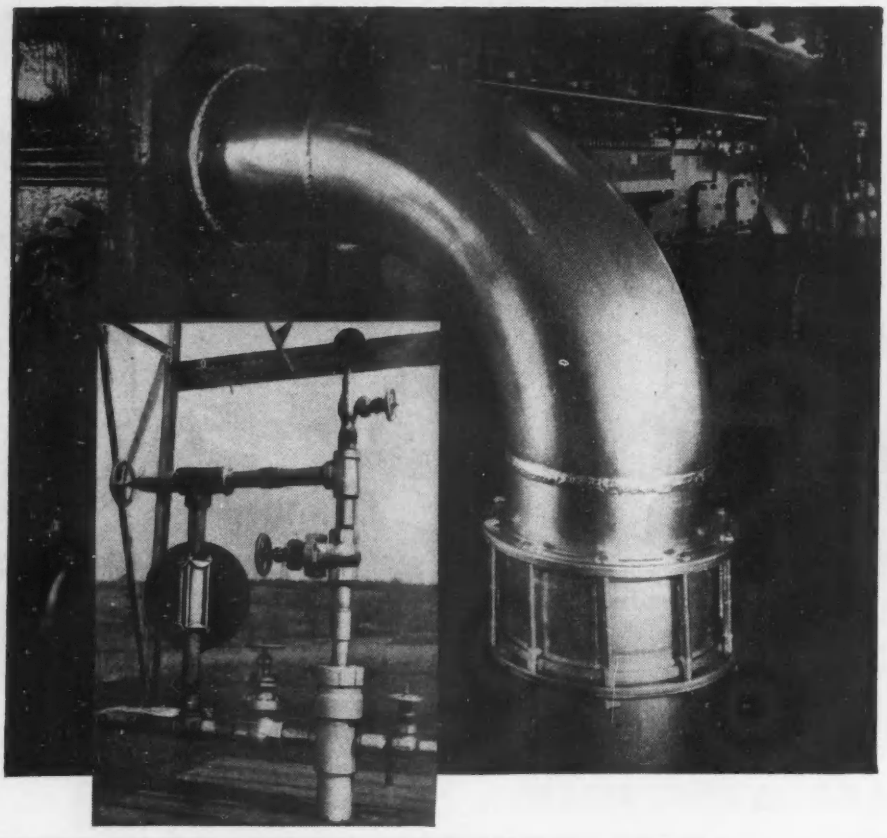
with a three-inch threaded pipe nipple to which a ground joint union is attached connected to a convenient length of flexible metal tubing. The second muffler is made of 12-inch pipe having four partitions with perforations to break up the flow of exhaust gases. The inlet connection is a three-inch line with a ground joint union to connect the end of the flexible tubing leading from the tail pipe of the first muffler.

Tail pipe of the second muffler is a ten-foot joint of six-inch pipe attached at right angles to the body of the muffler, and lies horizontal on the ground. This installation has operated so successfully that no complaints have been registered by families living in the immediate vicinity of the pumping station.





HOW TO—
Handle Long Hose

A two-wheeled dolly made from one-inch pipe and three-fourths-inch rod material will facilitate considerably the job of handling long rubber hose used for cleaning purposes around the station. The device consists of an A-frame support mounted on two steel wheels and a reel. The dolly is made from the pipe

to conform to the shape illustrated. Apex of the A-frame support is located directly above the axle of the dolly wheels.

The reel is made from three-fourths inch rod material and a section of eight-inch casing which serves as the hub. Each end has been sealed and an axle has been welded to fit into a coupling which acts as a bearing at the apex of the A-frame. Water or steam is fed to the hose through a side connection which is welded to the end of the drum. This short piece of pipe opens into the axle and connects to the hose through a coupling. The outer end of the axle is attached to a swivel ell which permits the reel to rotate while fluid is supplied to the hose.

A short nipple terminated by a union makes it possible to reel the dolly to the nearest water or steam line equipped for the purpose and tie the hose to these lines. A gate valve at the end of the hose is used to control the discharge from the hose. After the hose has served its purpose, it can be quickly disconnected and coiled on the reel for future use. The swivel feature on the reel makes it possible to pull additional hose from the reel while jetting down the floor or drain ditch.

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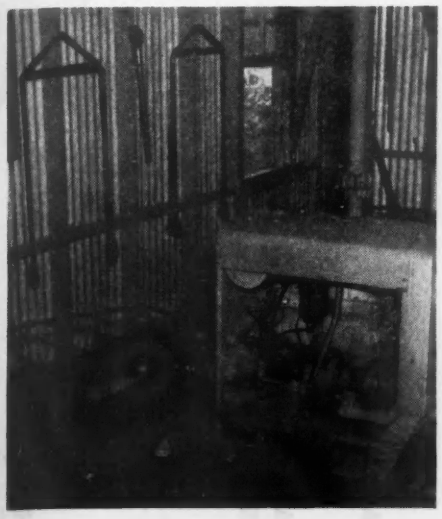
HOW TO—

Keep Engines Dry



Throughout the Gulf Coast bay and swamp areas, pipe line pumping stations must be set up in extremely low locations. While small, these stations are important and handle considerable volumes of oil from the remote coastal fields. In many cases, as in the one illustrated, the foundation of the engines and pumps are only a few feet above sea level. The uncertainty of floods and hurricanes make it imperative to provide some insurance for protection of equipment against high water.

In cases of emergency, oil can be left in the pumps and the line to afford some protection against being covered with water, but the engines cannot survive such treatment without major overhauls and replacement of the electrical system. In order to meet such an emergency, hoisting facilities were provided at one station to disconnect the engine from its skid and lift it eight feet to the supporting overheads. This would place the engine well above the water level, and perhaps save considerable repair costs.

Two brackets made from rod material were welded to form two U-shaped lifts, as shown hanging from the station wall. At the bottom of these lifts are large eyes through which a long rod may be inserted. This rod passes through matching holes in the engine frame, both front and rear. With two such brackets for each engine, a chain hoist can be hooked into both of them and raise the engine to the overheads in a very short time. Each of the three engines in this station are so equipped with a pair of lifting brackets for this purpose.

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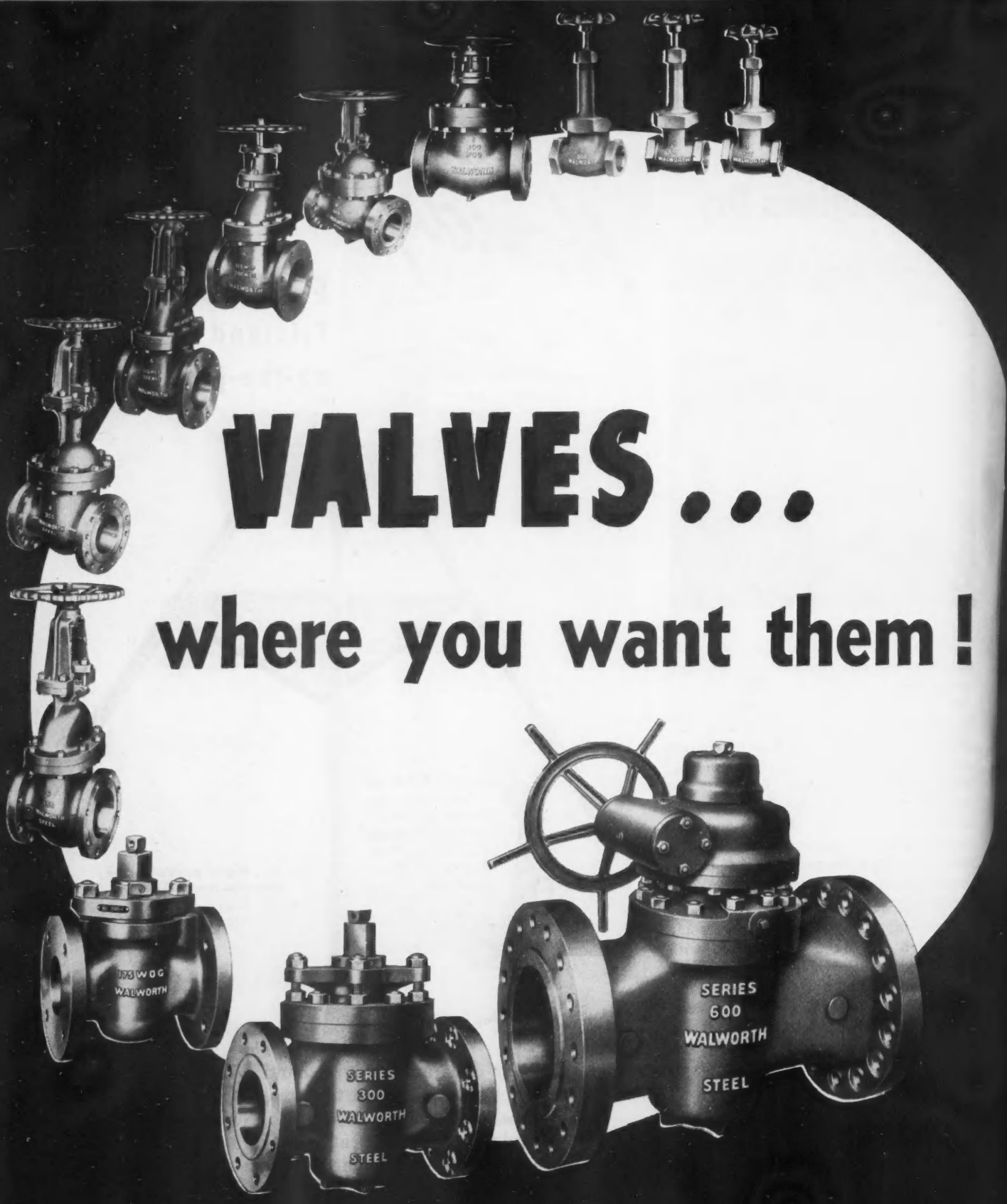

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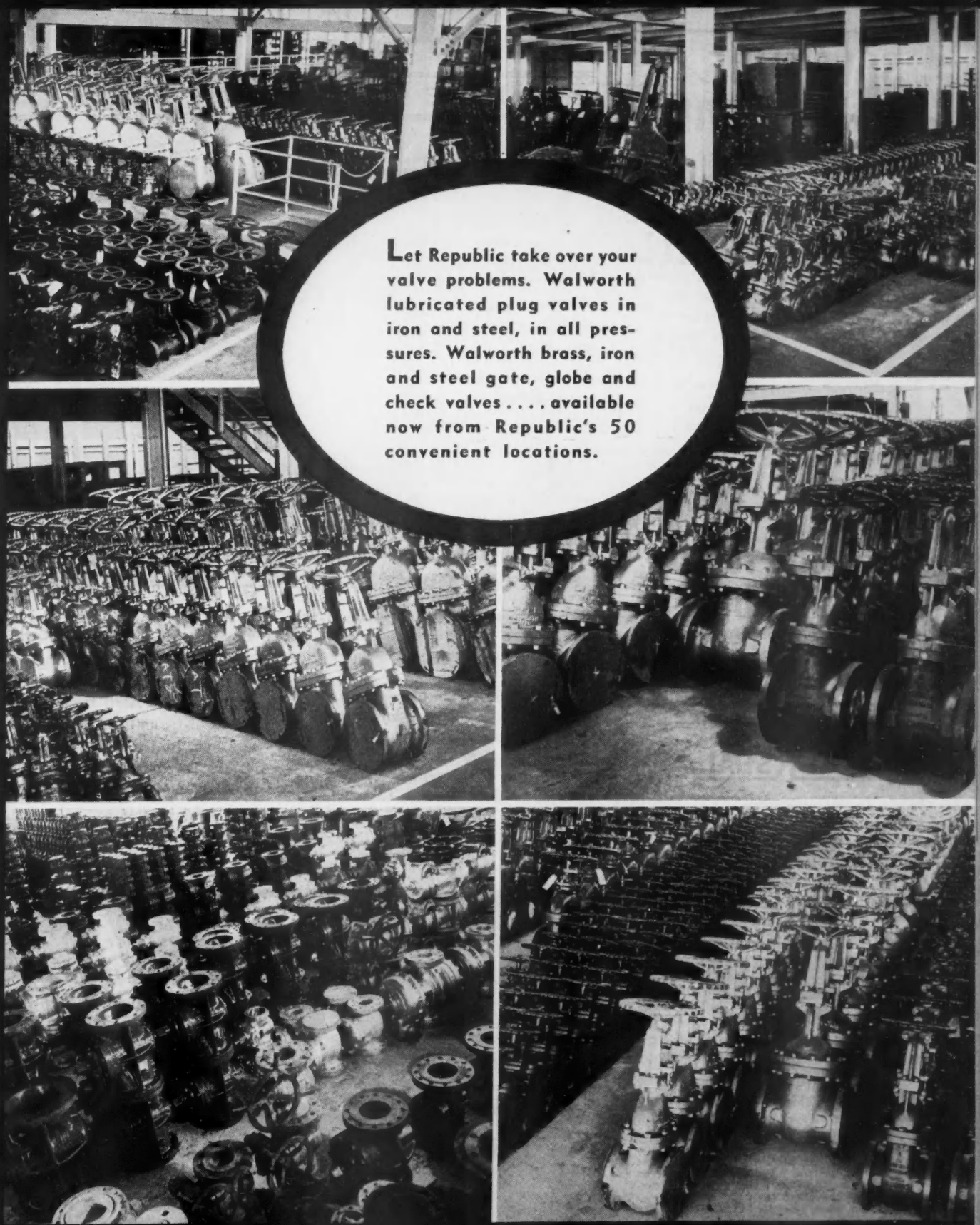

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PIPE LINE HINTS

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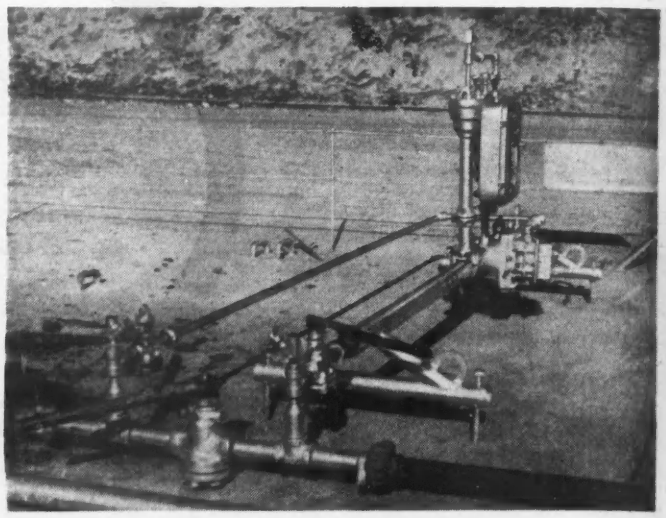

A meter run and all connections, including the orifice flange, can be built for moving and reinstalling on a gas line quickly without cutting pipe and fitting to each individual case. To provide a method of changing locations, the gas lines have identical fittings spaced the same distance apart so that the meter and meter run can be attached without difficulty. Gas under pressure flows to a take-off where several fittings, nipples, tees, ells, a plug valve and one-half of a ground joint coupling, or union, are installed.

Approximately ten inches downstream from the take-off is a lubricated plug valve followed by another group of fittings identical in style, number and size as the first connection either of which may be used as desired. The meter run is mounted on a support equipped at each end with leveling studs which rest on the concrete pad at the metering point, or may be set on substantial timbers. The gas flows from the meter orifice flange through a return pipe, paralleling the setting itself to be connected to the downstream fitting on the input pressure line. As the setting is compact and rigidly assembled, only two valves need be closed and one opened to remove the setting by breaking out the two ground joint unions.

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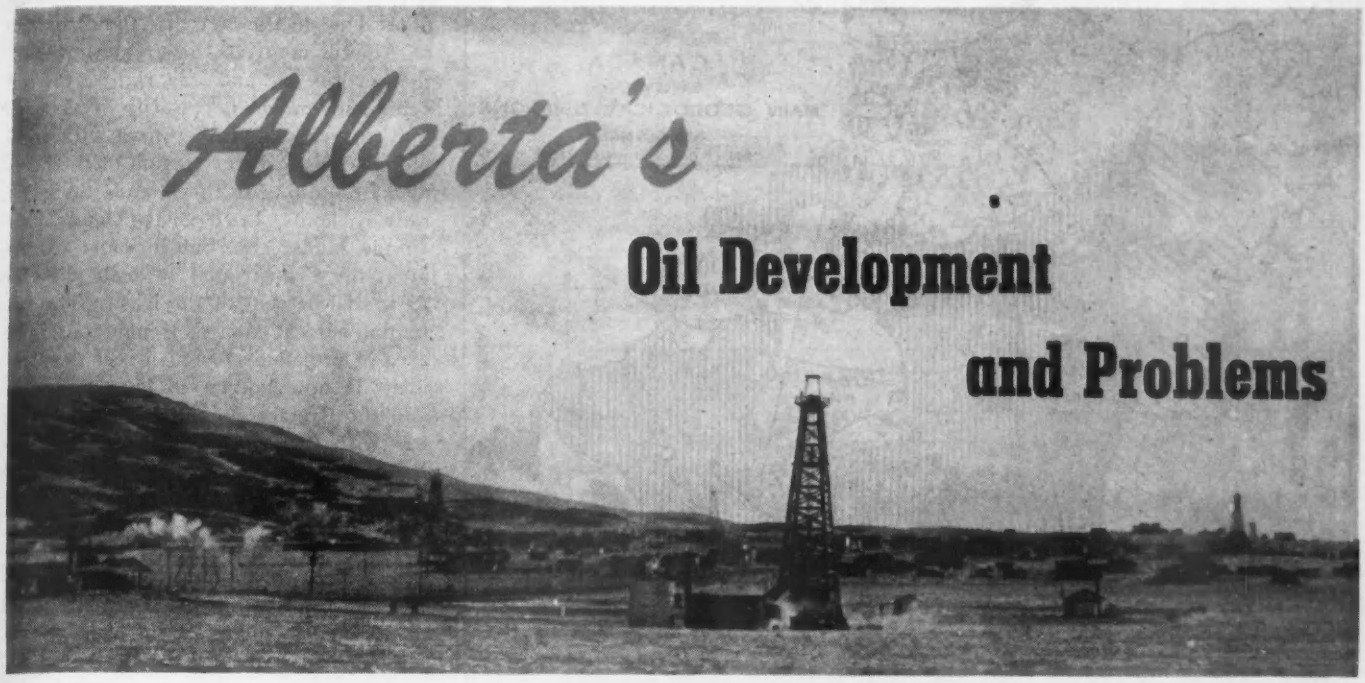

Alberta's Oil Development and Problems

By DR. THEODORE A. LINK

Consulting Geologist, Calgary, Alberta, Canada

THE prospective oil and gas producing area of Canada is enormous, as shown in Figure 1. The entire interior plains area contains sedimentary rocks capable of generating and storing oil and/or gas in the form of oil fields or pools. It lies between the Pre-Cambrian shield and the Rocky Mountains, and embraces an area of approximately 891,000 square miles, which is greater than the combined area of Texas, California, Oklahoma, Kansas and Louisiana.

In this area the geological column, a generalized cross-section of which is shown in Figure 2 in ascending order, holds promise of oil and/or gas as follows:

Oil and gas have been encountered in the Cambrian and possibly the Ordovician; none in the Silurian; the greatest developed reserves are from the Devonian; a considerable amount from the Mississippian; none in the Pennsylvanian and Permian; shows of oil in the Triassic; small oil and gas fields from the Jurassic; heavy oil, including the Tar Sands, and considerable gas from the Lower Cretaceous; and large and small gas fields from the Upper Cretaceous. Of these, the Upper Devonian holds the greatest promise, but it seems probable that additional large heavy oil and gas pools will be found within the Lower Cretaceous incidental to the search lower down in the Paleozoics.

Discoveries Since February, 1947

Prior to the Leduc discovery February 13, 1947, the proven oil reserves (produced and yet to be produced) for all of Canada were estimated at 200 million barrels of oil. However, since the discovery well was brought in at Leduc, 16 miles southwest of Edmonton, Alberta, more than ¾ billion barrels of oil have been added to the reserves of Canada. This latter figure is only an approximation and could very well be much higher.

Since the Leduc discovery there have been added to that field three extensions as follows: Woodbend, Section 9, and the Okalta group. The Redwater field, about 30 miles northeast of Edmonton, with reserves of more than 300 million barrels, was discovered in 1948; the Golden Spike pool where the discovery well revealed 540 feet of coral-reef oil saturation, with undetermined reserves west of Woodbend, was discovered early in 1949; Bon Accord, south of Redwater, is a field of undetermined size; a few weeks ago Gulf Oil Corporation of Canada drilled a discovery well about 80 miles southeast of Leduc, the size and reserves of which are unknown. All of these are of Upper Devonian age. Oil has also been found since the Leduc discovery in the Mississippian at Barrhead and near Hannah, about 200 miles apart, and small pools have been established in the Lower Cretaceous in that general area, to say nothing of the large gas reserves established incidental to the drilling for oil.

SINCE DISCOVERY of the Leduc field, expanded oil activities have brought a boom to Alberta which is unique in that there has not been a correlative trend in the stock market. In this article, which is slightly digested from a talk presented before the annual meeting of the National Oil Scouts and Landmen's Association in Houston June 10, the author surveys the problems encountered by operators in relation to government regulations, prices, proration and markets.

Crude Production

Figure 3 shows crude production for all of Canada from 1900 to 1949 with the names of the fields giving rise to the several upswings of which the Leduc and subsequent discoveries are the most pronounced.

The earliest production in Canada came from the Petrolia, Ontario, fields where drilling antedated the Drake drilling in Pennsylvania by a few months. From these shallow fields somewhat more than 30 million barrels were produced. It will be noted that the shallow Cretaceous, production in Turner Valley was discovered in 1914; the gas cap in the Madison limestone in 1924; and the west-flank crude from that same field in 1936. Although the Norman Wells field was discovered in 1920, and the Canol project developed it in 1943-44, the production from this field shows little effect on the graph. The Leduc and Redwater fields cause the late sharp rise on the graph.

There is an "oil boom" but not a stock

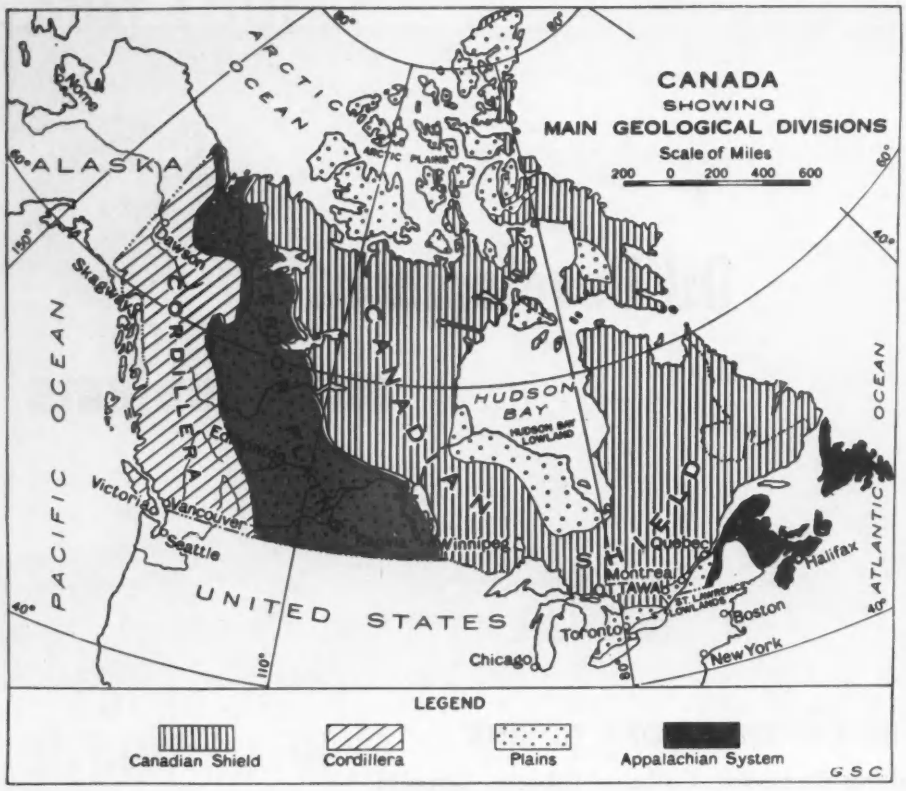

FIGURE 1

market boom going on in Alberta, but of a nature different from any previously experienced by oil operators, lease hounds, oil scouts, promoters, etc., from the U. S. as well as Canada. They find it difficult to decide just exactly how to handle the situation or how to "get in" on the play. It is not an "oil boom" in the same sense as, for an example, the Ranger, Texas, boom of 1918-19 which was confined to one or two counties, nor is it similar to many other previous oil booms in the U. S. wherein there was involved only one pool and its extensions coupled with small-sized leases usually controlled and owned by the owner of the surface rights; and as already stated, there is no typical Western Canada oil stock market boom.

There are many reasons why this present Alberta "oil boom" is in a class by itself and will consequently be handled quite differently from such local booms as referred to. In the first place, the Leduc discovery 16 miles south of the capital of Alberta is a coral-reef oil pool located in an area of sedimentary rocks so large that it could embrace Texas, Oklahoma, Louisiana, Kansas, Arkansas and California. With such a discovery, in such a vast area, the obvious question arising is, what is the trend? Where shall one take out leases? Can leases be obtained adjacent to the discovery well? Should one look for new pools or try to "horn in" on the individual pool? Due to the fact that the Province of Alberta controls the greater proportion of the oil and gas rights, the oil companies must necessarily deal with that government, rather than with individuals for a greater portion of the acreage. In addition to these lands there are railway lands, land-grant lands, fee-simple lands, etc., but in most of the areas the Crown must be dealt with for 75 to 100 percent of the leases. The potential wildcat area is tremendous. The area of probable Devonian reef development is now known to be very great, and the Cretaceous beds, which contain gas with the occasional crude accumulations, are likewise widespread. Exploration activity is now at an all-time high.

Current Exploration Activity

There are 12 or more major oil companies exploring in Alberta today, and about ten companies which might be classed as semi-major or potential majors, while minor independents number about 50 without counting individual operators. There will be a minimum of 14 surface geological parties for various companies surveying in Alberta this summer season; 51 seismic parties and 11 gravity meter parties were operating as of May 1, 1949, and these will be increased during the summer months. Forty-one wildcat wells were being drilled as of that same date, but this number has already been increased. About 56 exploitation or development wells were drilling as of May 1, and more than 35 million acres of leases and prospecting permits are held by various companies and individuals in Alberta. This does not include fee-simple and railway lands. The daily production from Alberta fields is about 50,000 barrels, of which more than 70 percent comes from the newly discovered pools.

The price of oil as of May 1 for the light crudes (including Turner Valley)

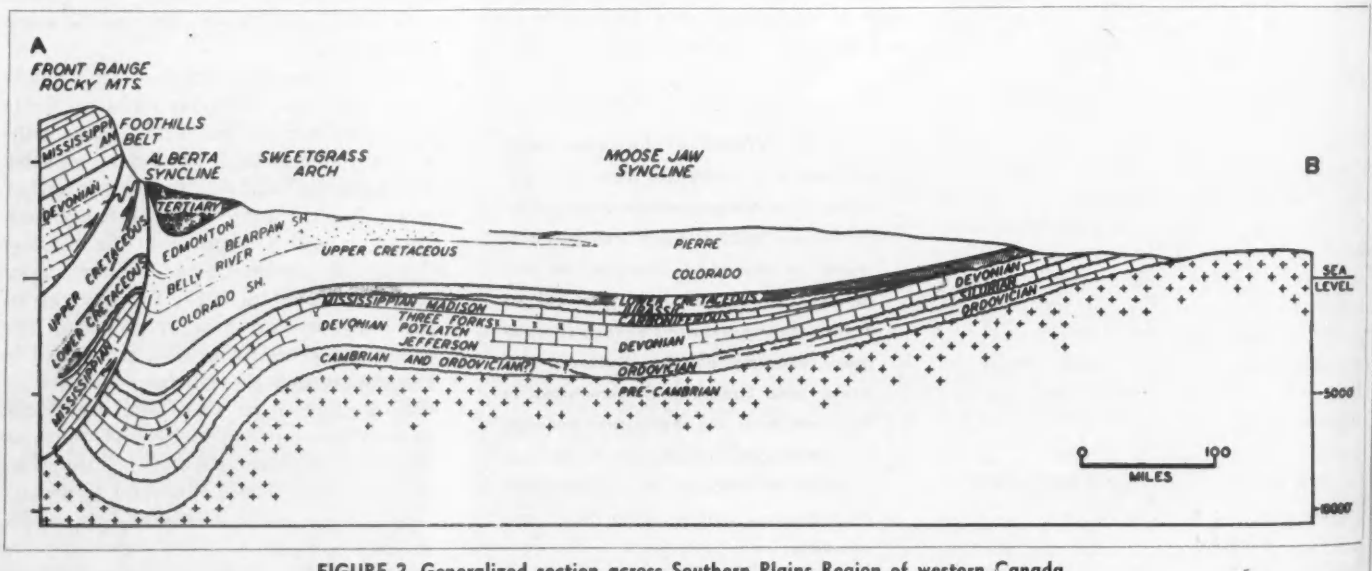

FIGURE 2. Generalized section across Southern Plains Region of western Canada.

ranged from $2.68 to $3.40 per barrel, and the Lloydminster heavy crude was bringing $1.30 per barrel. All new fields are prorated and further slight price reductions and voluntary proration is expected.

The figures on exploration activity enumerated are not impressive when compared to smaller areas within the U. S. However, the discoveries overshadow the actual finding rate of major oil pools at such shallow depths, in the same period of time within the U. S. by a generous margin. As suggested at the outset, there seems no doubt in the minds of experienced American operators, large and small, that this really is good country. However. people are beginning to wonder about the disposal of this oil, and the wisdom of looking for more with no immediate market in sight for the excess. The immediate Prairie Provinces Market of Canada could be saturated by 60,000 barrels per day.

Economics and Geography

Any discussion on this subject should be preceded with some figures regarding the economics and geography of petroleum production and marketing in Canada where everything is wrong. On Figure 4 is indicated graphically the location of the production of oil, and the demand for oil which shows clearly that, as of January 1 this year, Canada was producing approximately 13 percent of its crude requirements; that essentially all this production comes from Alberta; that about 70 percent of Canada's requirements are in a very small area of Eastern Canada about 2,000 miles from the main crude source; and that an all-Canadian pipe line would be an economic problem because of its length and the rocky terrain north of the Great Lakes over the Pre-Cambrain Shield.

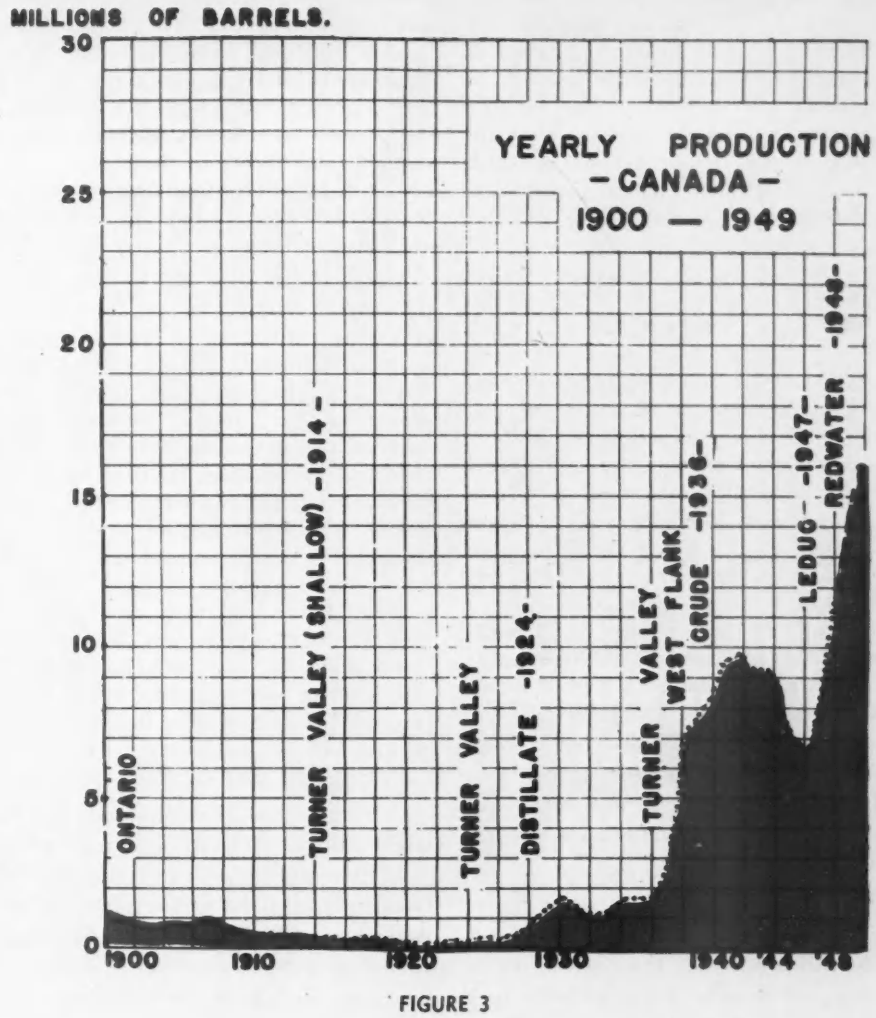

FIGURE 3

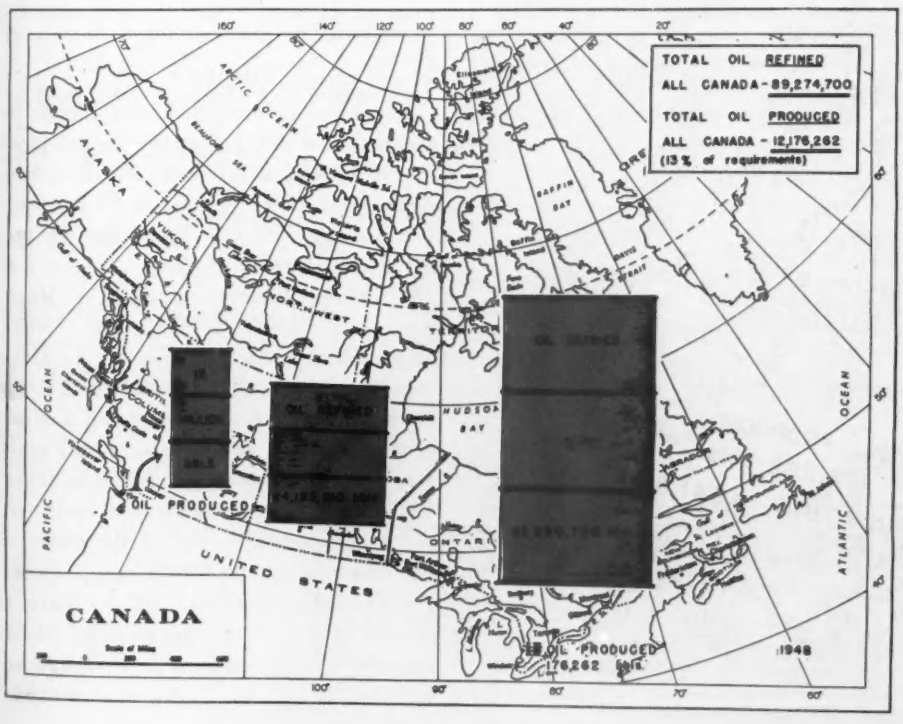

FIGURE 4

Figure 5 is a map showing a two-way division of oil production and population in Canada, and for your information the bulk of that Eastern population is concentrated in Southern Ontario and Quebec, where essentially no oil is produced. Because of the Rocky Mountains, the most densely populated area of British Columbia, centering around Vancouver, is also isolated from the crude producing area of Alberta.

Obviously the first step to create a ready market is to construct pipe lines within the interior or Prairie Provinces between the Pre-Cambrain Shield and the Rocky Mountains, but this won't help the problem much. That will mean only reduction in oil transportation costs and slight extension of markets, and is being undertaken by Imperial Oil, Ltd., by building a pipe line to Regina, Saskatchewan. Fortunately this pipe line will be of 16-inch diameter with the object of extending it to the head of the Great Lakes from which, during the open water season, it can be tanked to Southern Ontario. However, that again is not enough if the reserves of Western Canada keep on increasing as has been the case since Leduc, February, 1947.

A pipe line across the Rocky Mountains would seem a reasonable propo-

sition at the present time, not only for refineries in Canada, but also for the northwest coast of the U. S., in view of the decelerated addition of reserves in California. As already pointed out, the Canadian requirements for 1948 were approximately 90 million barrels, of which 65 million were for Eastern Canada and 25 million for Western Canada, the latter including the Prairie Provinces and British Columbia. Ninety million barrels for 20 years would require 1 billion, 800 million barrels reserves, but that much is not yet positively in sight. However, for Western Canada, including the coast, the requirements are 25 million a year, and for 20 years this would require only 500 million barrels, which are positively developed as of today. Thus pipe lines to Regina and Winnipeg, and one to the Canadian Pacific Coast could be built knowing that there are adequate reserves for more than 20 years, even though there will be an increase in demand above that of 1948. For defense purposes, in case of war with Russia, a pipe line to the Coast would obviate the necessity of a repetition of another Canol Project orgy, and the same applies to a natural gas pipe line to that same area from Alberta. Such matters are now receiving attention.

Increase Reserves

As already stated, there seems to be enough oil in sight today to build such a pipe line to the Pacific Coast. However, assuming that it is feasible and economical, the industry could then continue to wildcat for more oil, with the ultimate object of extending the Edmonton-Regina pipe line not only to the head of the Great Lakes, but also to the Minneapolis and Chicago areas. Before such a proposition is taken too seriously, the present known reserves must be increased, and therefore there should be no letup in wildcatting activities even though proration and price reductions are more stringent than now.

Assume now that the building of a pipe line to Whiting, Ind., in the Chicago area were justified. From there to Sarnia, Ontario, is merely a short extension which could be constructed to take care of part of the Eastern Canada market without the necessity of laying a line over the uninhabited and rocky Pre-Cambrian Shield area north of the Great Lakes. The advantage of such a line through the thickly populated portion of the U. S. is obvious. If the Canadians wished, they could insist upon priority of oil for Southern Ontario, and delivery of oil along the line could then be initiated, should the reserves grow large enough. In other words, this would be an international proposition in which Canada would have considerable to say.

Delivery of Canadian oil into that area might crowd out American production and, from past experiences and present day reactions on the part of some smaller American independents, a big howl would go up if something like that is proposed. In every country there are usually two groups, one believes in conserving its resources to a point which is ridiculous, and the other wants to sell all it can as quickly as possible. As a matter of fact, a deal of this sort would stir up these opposing factions within the U. S. and also within Canada. Those Canadians who believe in exporting oil from Canada into the U. S. would side with those Americans who want to conserve; while the Canadians who believe in conserving their oil for Canada would side with the Americans who did not believe in that for their own country. That is, "necessity would make strange bed-fellows." An example of this sort of thing was the recent gas export hearing conducted in Alberta wherein one group attempted to secure the support of the voters by advocating a policy to allow no export of gas from the Province unless a certain number of years' reserves could be established and a guarantee that the price of gas to the Alberta consumer would remain the same as today. The latter appears as "just silly," and the first stipulation is similarly silly, for the simple reason that if the present generation in Alberta were to ensure, let us say, 50 years of certain supply of gas, how about those living the 51st year?

When public sentiment is aroused about such matters as this by those who have axes to grind, I can't help but think of an analysis of the votes cast on the liquor question or prohibition which usually reveals that the bootleggers and the clergy voted the same way. All of this certainly suggests that the two countries would do well to set up a joint board or commission to handle such matters of oil production and distribution in the same manner as all other defense, aviation and related problems must eventually be considered in North America by Canada and the U. S.

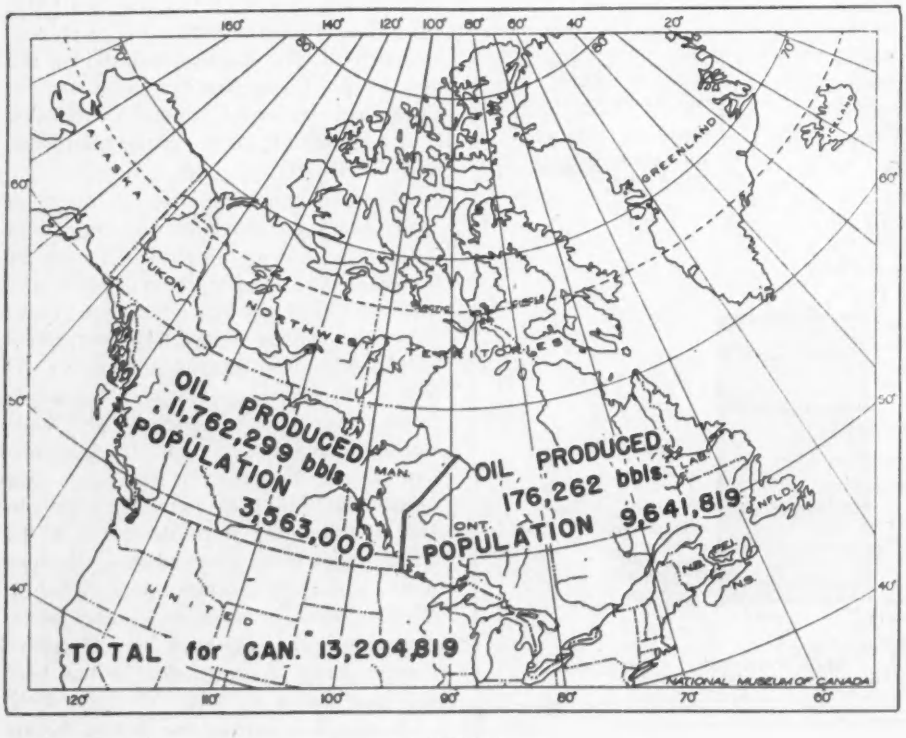

FIGURE 5

Summary

Summing up the pipe line problem, it seems that in addition to the 16-inch pipe line to Regina, a line to the Pacific Coast needs immediate serious consideration, because there appear to be enough reserves established to take care of the Prairie and Vancouver markets. More reserves are needed to justify the Minneapolis-Chicago-Sarina pipe line project, and therefore the wildcat activities should be accelerated for long-range planning which, of necessity, is the only way for the petroleum industry to function. It's a North American security or defense proposition and is therefore of international scope. Both major companies and independent oil operators should share in this business, which should be conducted so as to be above criticism from socialistic and communistic political bombardments.

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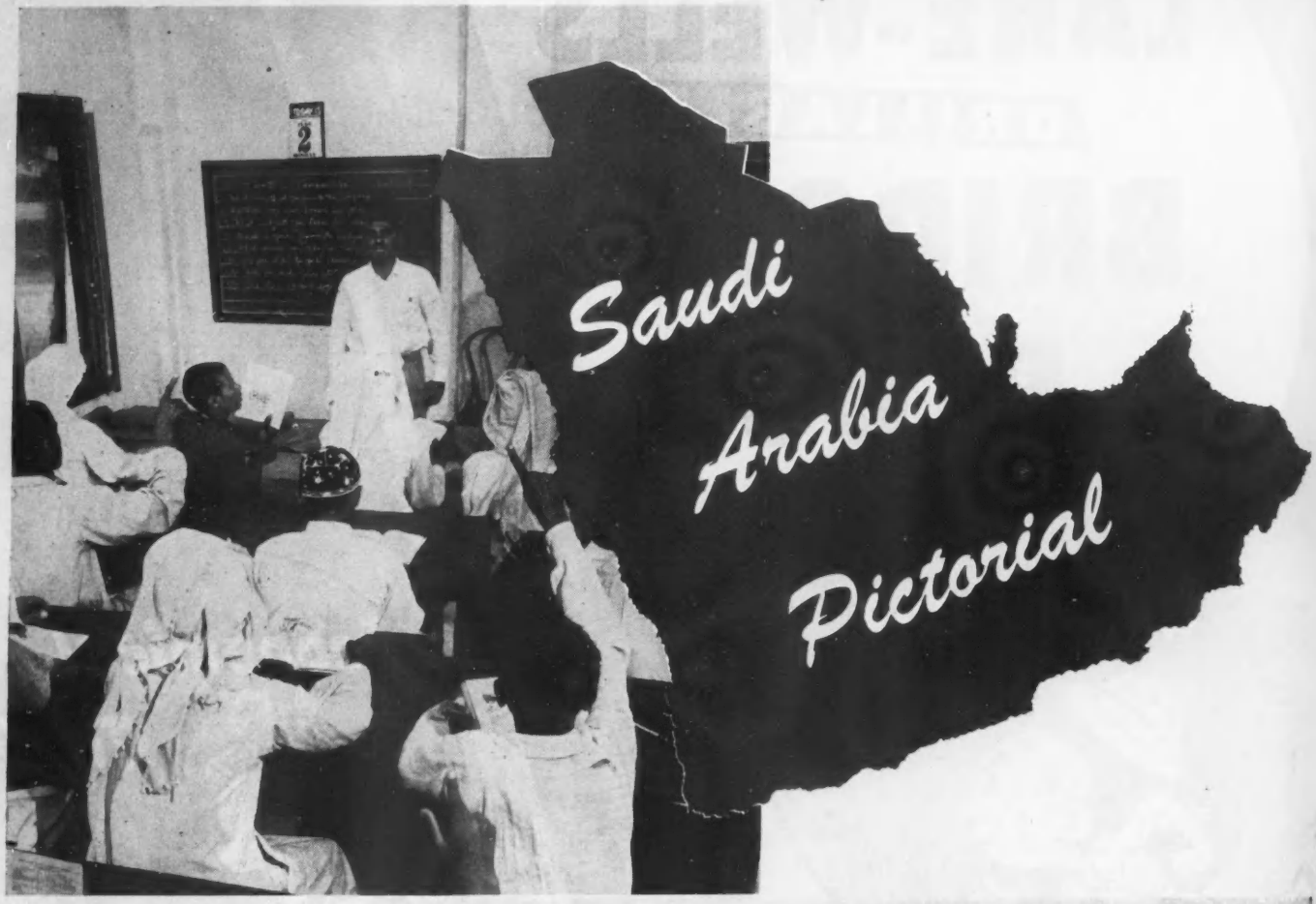
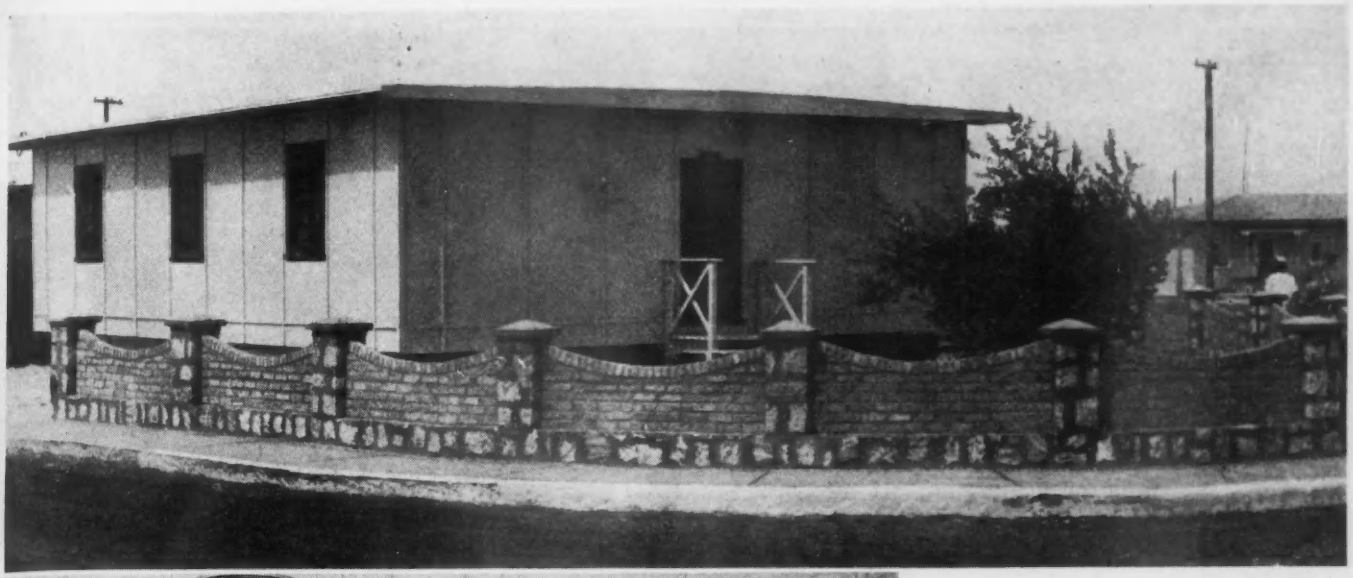


ABOVE: Arab boys study English in their classroom at the Aramco-sponsored Jebel School at Dhahran.

RIGHT: Recess time for American school children at Dhahran. Each of the three schools built by Aramco for American children is air-conditioned.

BELOW: A view of residential section of Dhahran. California-type bungalows are air-conditioned and have electricity, gas and telephones.



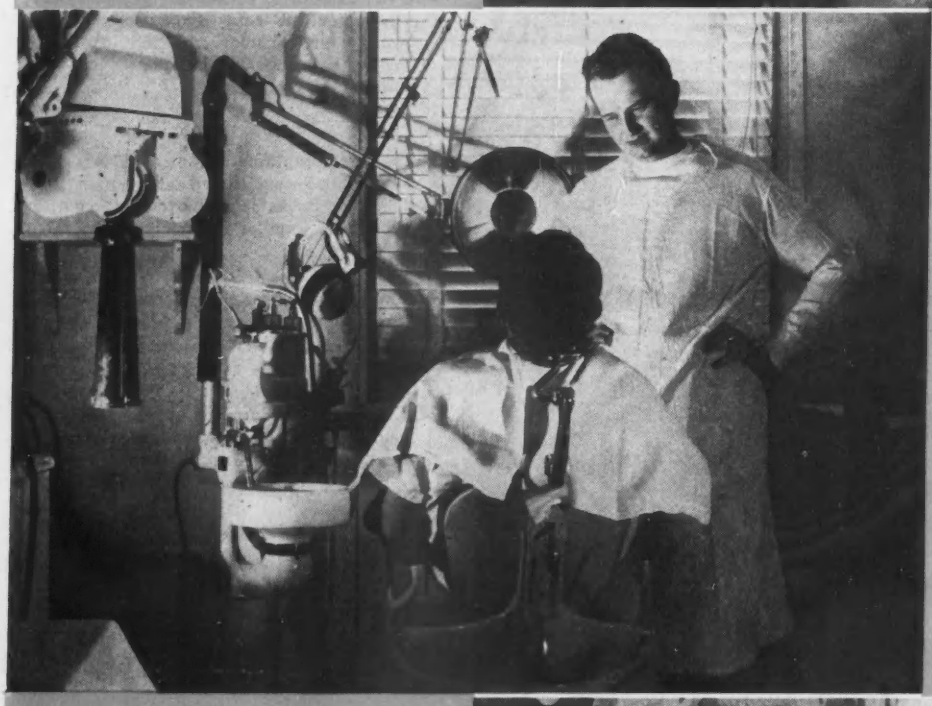
ABOVE: Exterior of permanent portable housing, typical of bungalows provided by Aramco for bachelor employes. Furnished for eight occupants, bungalows are air-conditioned.

LEFT: Looking down the center aisle of Aramco's air-conditioned dining room, provided for bachelor employes and married men whose families are not yet with them.

BELOW: Administration building at Dhahran houses many of Aramco's different departments.

BOTTOM: Brick dormitories being built for Saudi Arab employes stand in contrast to the Barrasti huts seen in the background.

In pleasant dormitory sitting rooms, Aramco employes relax at coffee. Unmarried women employes of the company sign for 24 months in Saudi Arabia.



The dental office in the American hospital at Ras Tanura on the Persian Gulf Coast of Saudi Arabia. Aramco maintains an adequate medical and dental staff in its hospitals and out-patient clinics in Saudi Arabia.

A geography lesson at the American school at Dhahran. Children of Aramco employes attend classes directed by licensed American teachers. Curriculum followed is similar to that of primary schools in the U. S.

Britain Lassoes Argentina Oil Market

By HENRY OZANNE, Staff Writer

BRITAIN has taken its first definite step toward the domination of worldwide oil markets, and many industry leaders now believe that U. S. oil has forever lost its dominant position in global trade. The trend toward British petroleum supremacy—which has been going on quietly behind the scenes for just 12 months—was given its most important impetus recently when the British government signed an agreement with Argentina to supply that country its oil requirements for the next five years. Similar deals are virtually concluded in other parts of the world, including Scandinavia and Europe.

Behind Britain's Expansion

One year ago, with the launching of Economic Cooperation Administration aid, Britain's sterling oil made its initial bid to win control of existing dollar oil markets. The British petroleum industry and the British government are so intermeshed that, as one company official expresses it: "You can't tell where the British Foreign Office stops and the British oil companies take over." The British petroleum expansion program is being furthered by two basic factors, one political and the other economic: the declared policy of the British government to push to the limit Britain's overseas trade, and the acute dollar shortage that prevails in most countries.

In practically every area of the world today where oil is used, dollars are scarce—too scarce to pay for the purchase of American oil, especially in the face of increasing quantities of sterling oil being made available through the vast British setup in production, refining and marketing activities. Argentina is a significant example of that dilemma.

Britain has agreed to supply Argentina 5,700,000 tons (42 million barrels) of oil a year, of which 1,800,000 tons will be crude. The remainder will be mainly heavy products. In return for this, Argentina will furnish Britain with meat, grain and linseed.

Argentina has been importing about 39 million barrels of petroleum annually. American oil companies have been receiving about $115 million yearly from oil exports to Argentina, and British companies have been deriving $4 million from oil shipments. Most of Argentina's imports have been coming from the Caribbean area, and chiefly from three American companies, Standard Oil Company (N. J.), The Texas Company, and Socony-Vacuum Oil Company, while the Shell Group has been the principal British supplier.

Argentina's oil consumption at present is about 155,000 barrels a day, of which 65,000 barrels daily comes from local production. Thus, the import volume now used runs to about 90,000 barrels a day. Argentina exports a small amount of specialty crudes and products to the U. S. In 1948 these totaled only 1,400,000 barrels of crude and about 670,000 barrels of refined products, mainly lubricating oils.

Britain's Source

Both Venezuela and the Middle East will be the source of British oil for fulfillment of the British export quotas to Argentina in the next five years. The refined products will move in from Shell's plant at Curaçao.

Other displacement of dollar oil by sterling oil is taking place on the continent of Europe and in Scandinavia. In Sweden, for example, three American companies and two British companies supply Swedish requirements. Until recently the market situation there has been competitive. However, the Swedish government has sharply reduced the amount of dollars available for U. S. oil, and the American firms have been drastically curtailed in their operations. In Denmark and elsewhere American companies are facing the alternative of shrinking their business volume in view of the dollar shortage, or accepting sterling payments in the hope of being able

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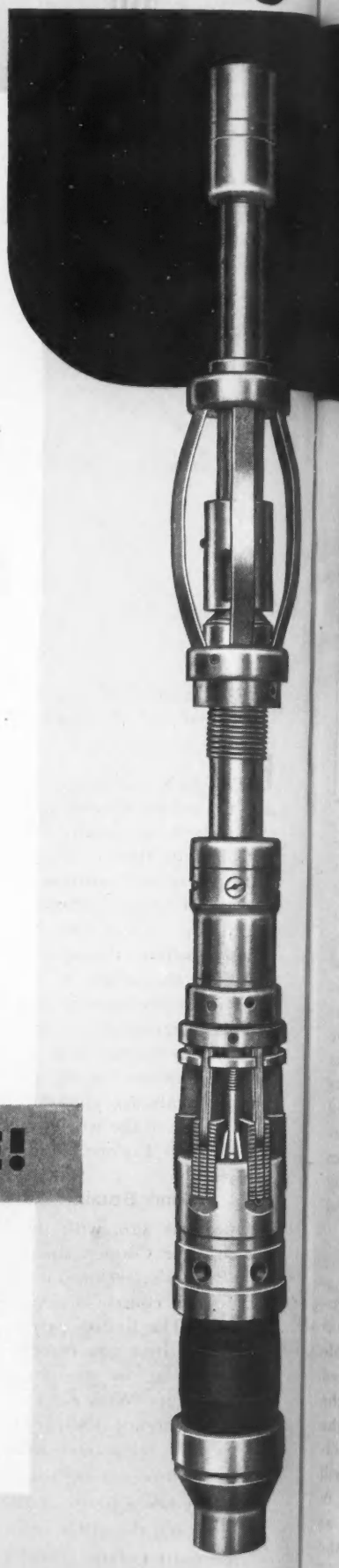

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Oil in Venezuela

VENEZUELA'S tax policies are weakening the position of Venezuelan oil in the world markets, according to a study recently completed by Dr. Joseph E. Pogue, petroleum economist and vice president of the Chase National Bank, New York. Unless present rising cost trends are reversed, he said, Venezuela will find it increasingly difficult to compete with lower-cost Middle East crude and with crude oil from new Canadian fields.

The situation has been brought into focus by the current shift from a sellers' to a buyers' market in world petroleum trade. Under the changing conditions, said Dr. Pogue, "no single oil-exporting nation can hold a preferred position in the international oil trade. Investment and producing costs in Venezuela will assume a decisive role. Much will depend on whether that country maintains a competitive status or permits itself to become a marginal source of supply subject to the second choice of consumers." He noted that Venezuela is dependent on export markets for nearly 90 percent of its oil output and is dependent on oil for two-thirds of its budgetary income. This income, according to Dr. Pogue, is contributed by 12 companies which have invested more than $2 billion in Venezuelan oil, the initial capital having been supplied almost entirely from outside the country. The oil revenues have grown nearly eight-fold since 1943, while other revenues has almost trebled. In 1948 Venezuela collected $411 million through direct and indirect taxation of the oil business and $162 million from other sources. This degree of dependence upon oil, a source of both weakness and strength according to Pogue, is "weakness because it places too many eggs in one basket; strength, because it is a good basket to have them in."

Since discovery of the first commercial oil in Venezuela more than 13.5 billion barrels of crude petroleum have been found. More than 4.5 billion barrels have already been produced, and current estimates of proved reserve stand in excess of 9 billion barrels. Pogue suggests that as much oil remains to be found as has already been located. The greater part has been found in the Tertiary formations of the Maracaibo-Falcón, and the Orinoco basins, but the Cretaceous formations which are known to underlie much of the oil territory have scarcely been scratched despite the great promise held by the recent discoveries in that formation. In addition the third petroliferous basin, the Apure, is virtually unexplored. Sedimentary studies indicate several decades of search will be required to define the resource, and much longer to exhaust it.

THE ACCOMPANYING material and illustrations are from a 49-page booklet, "Oil in Venezuela," published in June by the Chase National Bank, New York. It was prepared by Dr. Joseph E. Pogue following an extensive on-the-ground survey of the Venezuelan petroleum industry, and is based on an address presented at a meeting of the Associacion Venezolana de Geologia, Mineria y Petroleo, Colegio de Ingenieros. Dr. Pogue visited the nation's principal oil fields and discussed economic matters with leading officials, businessmen and bankers as well as with officials of the operating oil companies. The book goes into all phases of resources, industry, markets, economy and other factors influencing a great industry financed largely by outside capital.

Future Production

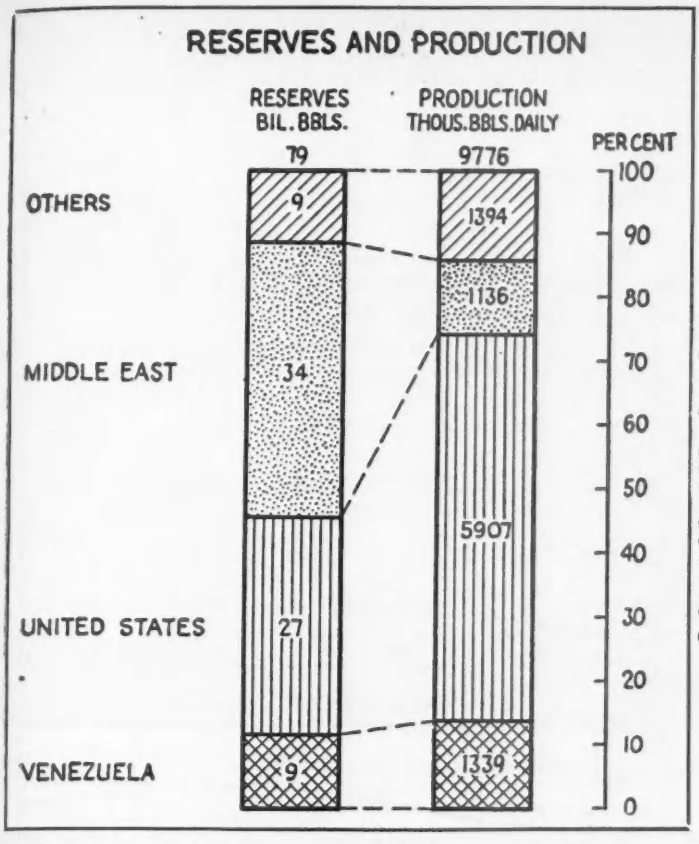
The future of Venezuela's oil production will depend upon rate of exploration and the growth of accessible markets. Exploration will be influenced by availability of concessions and the possibility of profitable recovery of the large investments involved in prospecting them. Availability of markets will be greatly influenced by cost levels in Venezuela. Pogue thinks Venezuela as a matter of self-interest should heed the admonition: "Do not lose the customer."

Citing the effect of taxation on the petroleum industry, Pogue points out

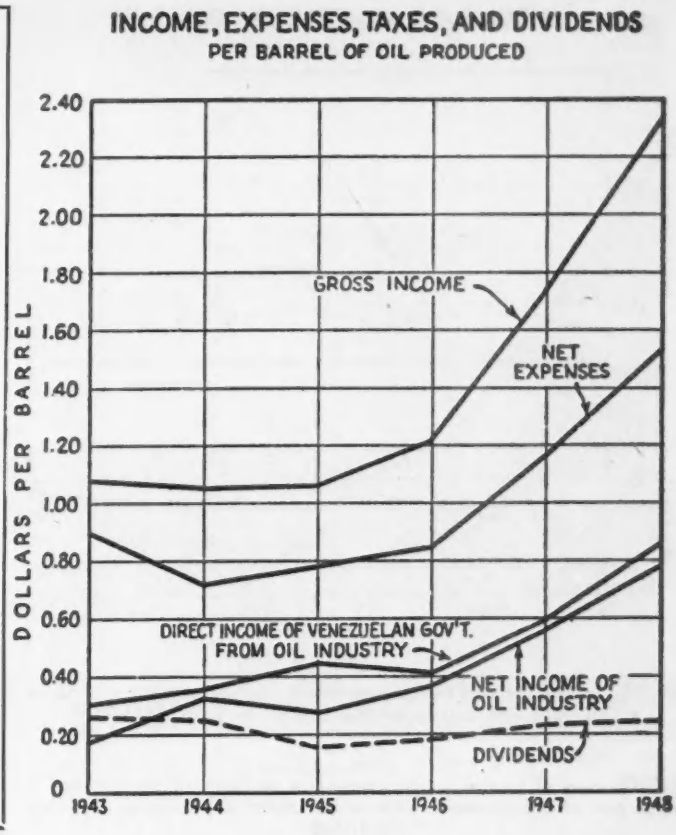
Direct Oil Taxes Per Barrel of Crude Oil Produced Compared with Various Income Items
Data Based Upon 12 Venezuelan Oil Companies, by Years, 1943-1948

	1943	1944	1945	1946	1947	1948	Total for Period
Crude oil produced*—million barrels	179	257	323	388	434	477	2,058
Total direct taxes†—Million Dollars	55	94	146	163	262	411	1,131
Taxes per barrel—dollars	0.31	0.37	0.45	0.42	0.60	0.86	0.55
Net expenses per barrel—dollars	0.90	0.72	0.78	0.85	1.17	1.54	1.06
Net income per barrel—dollars	0.18	0.33	0.28	0.37	0.57	0.79	0.47
Taxes in percent of net expenses	34	51	58	49	51	56	52
Taxes in percent of net income	172	112	161	114	105	109	117

* Excludes government royalty taken in kind.
† Direct taxes include royalty, income tax, import duty, concession-carrying taxes, initial exploration and exploitation taxes, annual exploitation taxes, services, and miscellaneous taxes.



Oil reserves and production of Venezuela compared with other areas. Figures represent January 1, 1949, for reserves and 1948 for production.



Income, expenses, taxes and dividends per barrel of oil produced by the Venezuelan oil industry, by years, 1943-1948.

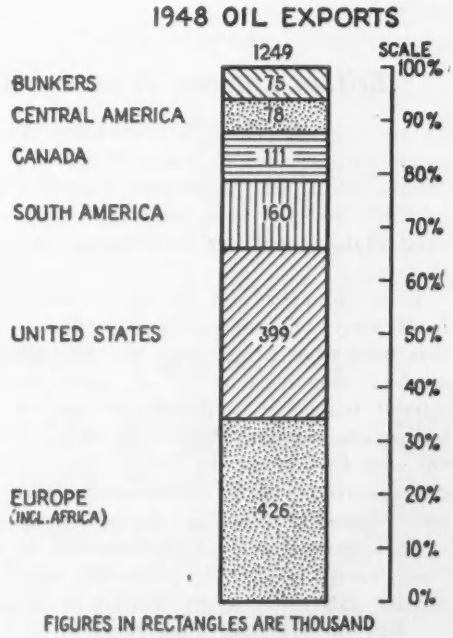
that the Petroleum Law of 1943 was designed to provide the Venezuelan government, through royalty and other taxes, an income equal to the net profits of the operating companies. However, in actual practice, the government's share is exceeding that ratio. At the same time companies operating in Venezuela have reinvested during the past six years 71 percent of the cash earnings, equal to 40 percent of the gross income obtained from the sale of the oil.

Ratio of Income

During this time the Venezuelan government has collected from the industry, in royalty and taxes, $1131 million, compared with the industry's net income of $971 million. For this period the ratio was 54-46, and the excess in favor of the government was $160 million. "In strict logic however, the only true return on an investment is the cash payment derived from it—dividends in the case of corporations. In the past six years the dividend payments of the Venezuelan oil industry have amounted to $440 million. Therefore the ratio of government receipts to industry's dividends was 72 to 28. Thus '50-50' has worked out on the more realistic basis of about '70-30'."

Other impedients to the industry's operations in Venezuela are seen in the requirement of local refining of part of the production, removal of exploratory concessions from the market, and the labor policy which has sharply increased costs of operation. The building of refineries necessitates large capital investments which are reflected in the over all costs.

Venezuela is already being displaced in European markets by lower-cost Middle East crude, Dr. Pogue says, despite the transportation advantages of 50 cents a barrel. Future exports, he holds, will depend on the growth of Western Hemisphere markets and the competitive delivered cost from other sources of supply. In the matter of Western Hemisphere supply, Pogue pointed out that Venezuela has a large transportation edge in such hauls as compared with Middle East crude, about $1 a barrel for New York, but warns: "Venezuela can successfully compete with Middle East crude in the Western Hemisphere provided producing costs in Venezuela in comparison with those in the Middle East can be held down to a differential smaller than the transportation differences. Such a level, however, will call for a prompt reversal of recent cost trends in Venezuela."

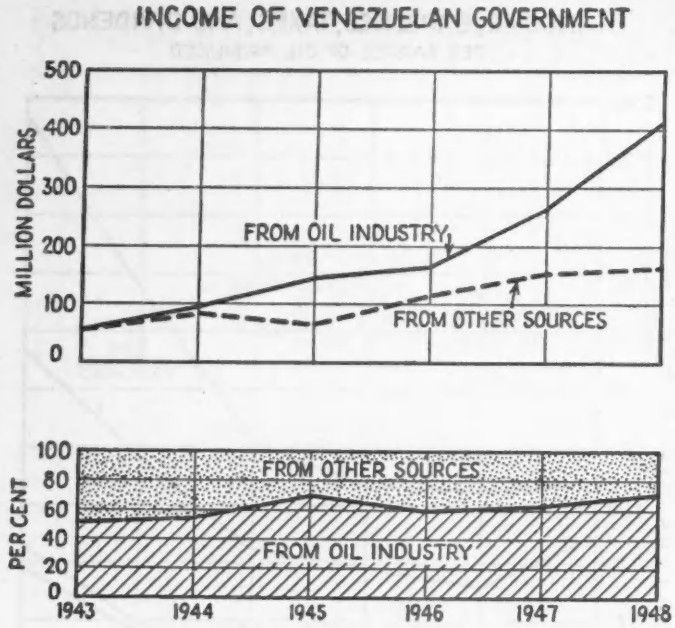


Destinations of oil exports from Venezuela in 1948, including re-exports from Aruba and Curacao.

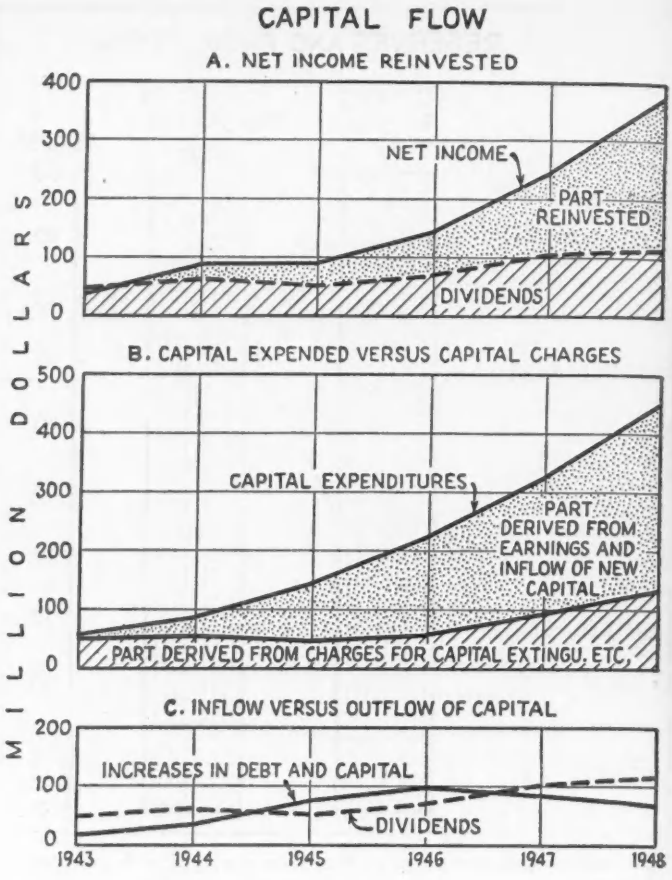
1943 Law Acceptable

He feels that, except for the policy of linking a refinery obligation to granting of new oil areas for development, which lowers the compitive position of the oil in world markets, the 1943 Petroleum Law appears to be generally acceptable and affords a reasonable working basis for the economic development of petroleum resources.

Although oil is the major source of income, Venezuela is in sound financial condition, having virtually no foreign



ABOVE: Income the Venezuelan government received from the oil industry is compared with that from other sources, by years, 1943-1948.



RIGHT: Flow of capital in the Venezuelan oil industry, showing how a large part of net income is required for capital expenditures, by years, 1943-1948.

or internal debt, and the government's income in 1948 was $130 per capita. Its currency is backed by gold in a ratio of more that 100 percent. It has many other resources in the form of minerals which include gold and diamonds, and much potential agricultural territory. Location and climate are favorable. However, its resources are relatively underdeveloped with the exception of oil.

Dr. Pogue emphasizes the dramatic features of employe relations in the Venezuelan petroleum industry. Employment is relatively stable and the work year is divided into 280 working days, 9 national holidays, and 24 vacation days, in addition to the 52 Sundays. Labor costs are among the highest in the world, with basic wage, bonuses, indirect pay and other benefits taken into account, amounting for the first half of 1948 to $15.13 per man per work day. The worker is allowed travel time to and from work, profit-sharing, medical attention, housing allowances or maintenance, educational facilities, and many others. Several companies have an additional expense of about 80 cents for retirement, group insurance and other benefits which bring cost to the company of the average worker to $4460 per year.

Can Compete Successfully

All of these factors contribute to raising living standards but also contribute greatly to increased costs of production. Should the trends be halted, Venezuela oil can compete successfully in the Western Hemisphere markets, according to Pogue. Its geographic position is favorable. Transportation cost by tanker to Europe is only half as much as from the Persian Gulf, and is in a better position to Western Hemisphere ports, but low production costs in the Middle East offset the transportation advantage and Venezuela crude is being displaced in European markets.

Pogue warns that Venezuela's oil economy renders it vulnerable to fluctuations of a single commodity in world trade and suggests it would do well to invest part of its oil proceeds in development of alternate resources and industries.

Britain Lassoes Argentina Oil Market

■ CONTINUED FROM PAGE 215

at some future time to convert these into dollars. British companies accept sterling payment and are able, under the Marshall Plan, to convert immediately into dollars.

Both domestic and foreign industry leaders say it is impossible to predict at this time what proportions this kind of trading may assume. It is generally agreed that if it continues British oil will easily supplant American oil in all the world's centers. In South America, distributors are highly concerned because of U. S. loss in important specialty lines.

ECA assistance to Britain is held at least partly contributory to the huge British expansion move. Britain is depending on Marshall Plan funds to increase by eight times its refining plant capacity, to double its overseas oil production, chiefly in the Middle East and in Venezuela, and to increase by 40 percent its overseas refining capacity.

The key to British oil policy lies in Middle East operations. The increasingly lush prospects for Persian Gulf oil sharply contrasts with other world areas, particularly the U. S., where production cutbacks have been effected. In the Middle East, on the other hand—where 65 percent of all production is sterling oil—output has increased from about 1 million barrels a day one year ago to around 1½ million barrels at the present time. The British-dominated Iraq Petroleum Company plans to step up Iraq production from around 50,000 barrels a day present rate to 125,000 daily this year while Iran's output is now 570,000 barrels a day. Also about three-fourths of the output from Kuwait is sterling oil, as Qatar production will be shortly.

Wild elephant herd photographed from the air during a recent mapping-magnetometer survey in Portuguese East Africa.

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U.S. Job-Seekers

Barred From Canadian Oil Industry

EFFECTIVE June 1, Canadian immigration authorities issued regulations which have the effect of closing the border to U. S. citizens seeking employment in Canada's growing oil industry. This, to some extent, may have grown out of the political turmoil preceding the general election of June 27, but it has other roots in a condition of partial unemployment which arose in Alberta fields following the stacking of 18 or 20 drilling rigs, in consequence of the glutting of the local market for crude. This situation may continue until steel becomes available for the construction of pipe line outlets now planned for increasing the radius within which oils from the new fields may be transported and sold. This ruling affects U. S. oil men of all categories: officials, engineers, geologists, and geophysicists, as well as drillers, production experts, supervisors, foremen, mechanics, specialists, roughnecks, and roustabouts.

Tourists who declare themselves as traveling for recreation and pleasure are unaffected, as Canada's well-settled policy is to do everything possible to foster tourism in order to strengthen her exchange position and add to her dollar balances. Pleasure seekers may enter the country as freely as before, under temporary permits not exceeding six months in duration; but, if a foreigner admitted under a tourist's visa should obtain employment in Canada, he would at that moment find himself in violation of the law.

Engineers, technicians, experts, drillers, and specialists may still be admitted from time to time, upon application of the prospective employer if it can be shown that no surplus of such talent or skill exists within Canada. Jobseekers have no standing as applicants on their own behalf. Such showings can only be made by employers, first, by application to the National Employment Service (of Canada) offering to hire unemployed citizens or residents of Canada possessing training, skill or experience as specified by the employer. If no such men, possessing suitable qualifications, are registered with the Employment Service, the applicant employer requiring the services of seismograph, executive, drilling and production personnel may then take his case to the Western Canada Petroleum Association of Calgary, counterpart of the Mid-Continent Oil & Gas Association of the U. S. If the association finds and will certify that no surplus of such workers exists within Canada, the employer's application will be endorsed to recommend favorable consideration by the Canadian Immigration Service; and, if the situation warrants, that service will clear the admission of the required personnel at a designated Boundary Port of Entry.

According to Bulletin No. 230, recently issued by the Western Canada Petroleum Association:

"Personnel admitted under the above arrangement will be granted Form '242' Temporary Entry Permits, and these will be subject to such extension as may be required, and as the circumstances call for, upon application of the employer.

"U. S. personnel who enter Canada under the above arrangement to do a specific job for a specific employer will not be permitted to transfer from the original employer to a second company, whether they quit their original employer of their own accord or are dismissed for any reason. Such men will be required to return to the U. S. immediately they separate from their sponsor, and the latter will be held responsible by the Immigration Service for the return to the U. S. of the employe whose services they no longer are utilizing in this country."

Some Must Leave

Some two-score of men, roughnecks for the most part, who were found working illegally in Canadian oil fields, usually after having entered as tourists, will be forced to leave Canada through cancellation of their permits. Others, who are working in Canada under temporary permits, as are all U. S. citizens employed in that country, are subject to the cancellation of their visas, or permits, as they expire from time to time.

The impression prevails among interested parties and affected personnel, whether rightly or wrongly, that, after the Canadian general election is over U. S. citizens of the skilled trades and professions, such as drillers, production supervisors, engineers, geologists and geophysicists who are regularly employed in Canada, and whose skill, training and experience are considered essential to the orderly development of Canada's newly-found oil reserves, may receive favorable consideration as their cases are reviewed from time to time by the Immigration Service as their individual visas expire.

E. W. Kolb, Secretary-Treasurer of Western Canada Petroleum Association, stated to a representative of WORLD OIL in Calgary that, as of mid-June, there was a surplus of roughnecks, roustabouts, drillers, supply salesmen, accountants and office workers; and that no surpluses were known to exist in the categories of well-trained and highly-qualified petroleum engineers, geologists and geophysicists. He gave it as his impression that American oil and oil-well supply companies in general may be allowed to bring in managerial and supervisory talent only to such extent as may appear necessary to train Canadian personnel. It seems obvious that, as time goes on and Canadian apprentices are trained, developed and qualified as journeymen, experts, foremen, and supervisors, many categories of highly-skilled American labor—such as drillers—may be excluded from employment in Canadian oil fields.

An oil or supply man wanting merely to look things over and survey the fields with a view to acquiring acreage or establishing a supply store could go in as a tourist. He could meet the trade, establish contacts, etc., but he could do no business, such as buying or selling, while here. If he wanted to buy leases or sell goods on such a visit, he would be required to clear himself through the Canadian Immigration Service, for which purpose the good offices and assistanec of the Western Canada Petroleum Association can be had upon application to E. W. Kolb, Secretary-Treasurer, 309 Lancaster Building, Calgary, Alberta.

Sinclair Abandons Oil Operations in Panama

Sinclair Panama Oil Corporation has ceased all operations in Panama and is withdrawing the last of its equipment from that country. This action by Sinclair followed failure by the National Assembly of Panama to renew the petroleum exploration agreement concluded several years ago. The company's deep test drilling on the south side of the Isthmus near Porto Armuelles was abondoned at 9700 feet, and machinery was sent back to the U. S.

Sinclair Panama is owned jointly by Sinclair, through its subsidiary Venezuelan Petroleum Company, and Cities Service Oil Company. Cities Service announced it had no further immediate interest in Panama under any other operating arrangement.

Late in 1948 Sinclair asked for a three-year extension of its exploration rights, but this request was tabled without action by the Panamanian government. The company held a concession of about 18 million acres, with rights for 20 years, on the basis of a $25,000 yearly payment during the exploration period, and rentals thereafter on retained acreage.

The original agreement provided that after an initial three-year exploration period the company could make a selection of acreage for continuation of the program. Sinclair was to have paid the Republic of Panama a royalty of 16⅔ percent on gross production of any oil or gas found under the contract, and in addition the government was to have received a 25 percent share in profits from the manufacture, transportation and marketing of petroleum products from locally produced crude.

Failure of the National Assembly to renew the agreement halted an exploratory campaign which has resulted in the drilling fo four wildcat tests by Sinclair and its associates, and which has included a large amount of geological and geophysical investigation of the Republic's petroleum possibilities. About a month ago the company had been planning ahead for its new work during the next phase of the contract.

Most of the geological work had been centered in Darien Province, where geological crews and gravitymeter parties had been working, with most of the emphasis on surface geology, and in Chiriqui where tests had been planned for the near future.

Two wildcat wells had been drilled on Columbus Island, west of Colon on the Caribbean side of the isthmus, between 1924 and 1928 at which time the company had held exploration concessions, and one test was drilled in 1948 to a depth of 8621 feet without finding showings of oil. A considerable amount of exploration was done between the expiration of the 1924-1928 agreement and the signing of the one just concluded.

In Costa Rica a contract has been signed between the government and Honolulu Oil Corporation of Los Angeles for exploration and drilling "for the account of the government over a period of 36 years." The contract provides for a six-year period of exploration followed by a 30-year period of drilling and production. Seismographic or other exploration work must begin within the first six months of the life of the contract and the first well must be drilled within two years. Areas included in the concession are in the provinces of Limon, Alajuela, Heredia and Puntarenas. At the end of the exploration period not more than 494,000 acres may be retained for drilling by the company.

Honolulu is to retain a percentage of production as payment, and after production reaches 5000 barrels daily, the company will have the right to construct a refinery.

Standard Oil Company of Ohio began active negotiations early this year for exploratory rights on a region comprising 2 million acres in the Peten lowlands of Northern Guatemala. The company has been conducting preliminary geophysical work for more than two years, during which time it has made a gravity meter survey of the entire area for which it is negotiating. The tentative contract specifies that if oil is discovered, Sohio will receive seven-eighths of the production.

Actual operations will be difficult, since they would be carried on in a jungle area which would require that all equipment be flown in, including heavy drilling machinery. With the discovery of oil it would be necessary to build a pipe line to a terminal at Puerto Barrios on the Gulf of Honduras, northeast coast.

During the past year other companies have been interested in Guatemala as a favorable region for oil exploration. The Atlantic Refining Company recently moved in gravity meter equipment and has started work. The same company has maintained two geological crews in the field for almost a year.

Until recent months there has been some drilling activity in Nicaragua, in addition to geological and geophysical work, but currently nothing is being done following abandonment of the latest well. The American International Fuel and Petroleum Company, participated in by Gulf Oil Corporation and The Atlantic Refining Company, abandoned Twara 1 in March, 1948, after drilling to 6267 feet, and continued its other prospecting work for some months afterward before moving the crews out of the area.

Twara 1 was near the northern extremity of Nicaragua's Caribbean coastline, about 22 miles north of Puerto Cabezas in Twara Lagoon. It is about five miles south of the same operators' Punta Gorda 1, which was abandoned late in 1945 at 6735 feet.

Negotiations on Iranian Royalties Are Suspended

The important negotiations between the Iranian government and Anglo-Iranian Oil Company in an effort to reach an agreement over oil royalties have again been suspended. At the same time it is feared in some circles that this may be the forerunner of discussions elsewhere in the Middle East for higher royalty rates on oil produced.

The disagreement in Iran is attributed by some British sources to the higher concession fees and royalty payment rates agreed upon by newcomers to the Middle East, as for example the two independent American groups which recently obtained concessions in the Persian Gulf area, and who are reported to be committed to royalties much higher than paid elsewhere in the region.

In the negotiations in Iran it is understood that the company's final offer was a scale, on a tonnage basis, plus a share of profits guaranteed not to fall below a figure of 2½ million pounds. The actual sum for the current year comes to the equivalent of nearly $75 million U. S. The government wants this figure as a guaranteed minimum. Actually it has been estimated on the basis of probable production and prices that payments next year will be on the order of $60 million.

Some Iranian officials with considerable backing want the dispute referred to the Hague Court or to the United Nations, while a few who have influential newspaper backing want to cancel the concession outright. The government also wants to make its claims retroactive for several years, but the company makes 1947 its limit.

Iran is currently the largest producer in the Middle East with an output for the first four months of 1949 of 557,345 barrels daily.

TAPline Construction Pushed With Completion Goal of 1951

TRANS-ARABIAN Pipe Line Company is stepping up its construction program so as to complete the cross-desert line from the Saudi Arabian producing fields to the Eastern Mediterranean by early 1951. The company, a subsidiary of the Arabian American Oil Company, owned jointly by Standard Oil Company of California, Standard Oil Company (N. J.), The Texas Company, and Socony-Vacuum Oil Company, will have all equipment and personnel for the line's construction in the field by August 1. Work will be pushed at both ends of the 1030-mile line which will start at the Abqaiq fields on the Persian Gulf and terminate at Sidon, Lebanon, 30 miles south of Beirut.

Clearance for the work was effected when the company and the Syrian government signed, after two years delay, a convention approving the project. Previous agreements had been signed with three other Arab states through which the line will pass, Saudi Arabia, Transjordan and Lebanon. The Syrian agreement was reached in effect late in 1947, but the Syrian Parliament held up ratification because of U. S. support of the Palestine partition plan. Although many operating details remain to be worked out, the recent accord with Syria clears the last major hurdle to the line's construction.

Provisions of Convention

The Syrian convention with TAPline provides:

1. The transit agreement shall continue for 70 years.

2. Transit fees are fixed in English pounds at the rate of 1.5/1000 of one pound sterling per ton of oil crossing Syria in the pipe line. At an exchange rate of $4 to the pound sterling, this fee equals about six-tenths of one U. S. cent per ton.

3. A 20,000 pound sterling ($80,000) yearly minimum guarantee is established on the basis of about 300,000 barrels a day movement. This throughput will be the approximate initial capacity of the line.

4. Syria will receive from TAPline 40,000 pounds ($160,000) yearly as "security" charges, covering policing and full protection of the line.

5. Syria retains the right to purchase approximately 1.5 million barrels of oil annually from the company at market price for use within Syria.

The company's agreement with Lebanon is similar except that the Lebanese are to receive two pence per ton on the oil crossing Lebanon, this "offtake" to cover port charges, fees and taxes in connection with the Sidon terminaling operations.

Although work on the line began at the Saudi Arabian end many months ago, it was virtually suspended last year because of the then unratified Syrian agreement and refusal of the Office of International Trade in Washington to grant the company an export license for its pipe. With both of those obstacles now eliminated, work on the pipe line is expected to reach about two miles a day shortly. About 250 miles so far have been laid up the Persian Gulf and northwest of Abu Hadriyah.

Welding crews are expected to meet in the middle of the Arabian desert, just south of the Iraq frontier, at the end of 1950. Meanwhile, port work at Sidon will be put under way, including construction of a pier, installation of submarine loading lines and erection of a tank farm comprising 16 tanks of 180,000 barrels each.

Total cost of the line, once set at $125 million, then revised to $200 million, may run nearly $300 million before completion. Aramco and TAPline have a $525 million expansion program under way in Saudi Arabia.

The opening of the line, with its initial 300,000 barrel-a-day throughput, will not permit sharp stepups in Saudi Arabia production which is already at optimum for current demands. In 1948 Aramco produced 142,852,000 barrels of oil—about 390,000 barrels a day for a yearly average—and production has been tapered off to about 500,000 barrels daily for 1949. The pipe line will start at the Abqaiq field which now has 34 producing wells with a total field output of about 420,000 barrels daily. Of the 24 new wells completed by Aramco during 1948, 18 were at Abqaiq, two at Ain Dar and four at Qatif.

Plans Are Made for First Aminoil Neutral Zone Well

American Independent Oil Company will spud in its first well in the Kuwait-Saudi Arabia Neutral Zone early in October. A geophysical party of 18 men worked the area from April 1 to June 3, and maps are now being prepared in Houston detailing the findings. Choice of the first location will be made shortly, and actual drilling operations will get under way as soon as the summer heat subsides in the region.

James MacPherson has resigned, effective August 1, as vice president and resident manager of the Arabian American Oil Company at Dhahran, Saudi Arabia, to become vice president and general manager in charge of American Independent's operations in the Neutral Zone. MacPherson will headquarter in Kuwait City, on the northwest corner of the Persian Gulf below Iraq. Commenting on plans, Ralph K. Davies, Aminoil president, said: "Exploration activities are well advanced and drilling and development work will go forward immediately in the area under concession."

Under the contract signed a year ago, Aminoil received a concession for full oil rights to the Sheikh of Kuwait's undivided half interest in the zone. The other half is held by King Ibn Saud of Saudi Arabia. Immediately adjacent to the Aminoil concession is the Kuwait Oil Company's Burghan field, which many geologists believe to be the world's largest petroleum reserve of an estimated 11 billion barrels.

Time Extension Is Granted For Saskatchewan Permits

The Department of Natural Resources of the Province of Saskatchewan, western Canada, has announced that three orders have been issued to make it possible to grant extensions of time in which preliminary geophysical and subsurface permits as well as lease contracts may be validated.

The spokesman for the government said this move was taken to facilitate the fulfillment of obligations and requirements which must be met by operators holding permits and leases in Saskatchewan. The number of permits whose term commenced on April 1, 1949, is too great for the availability of equipment and trained crews for carrying out geophysical activity and drilling.

A maximum extension of six months on permits and leases will be provided, based on difficulty encountered by each operator. "As evidence of good faith," the spokesman said, "the operator is required to deposit with the resources department a minimum sum of $5000 cash bond in respect of each permit or lease for which an extension of time is required." He stated that such cash deposits would be released on presentation of accounts for exploratory work.

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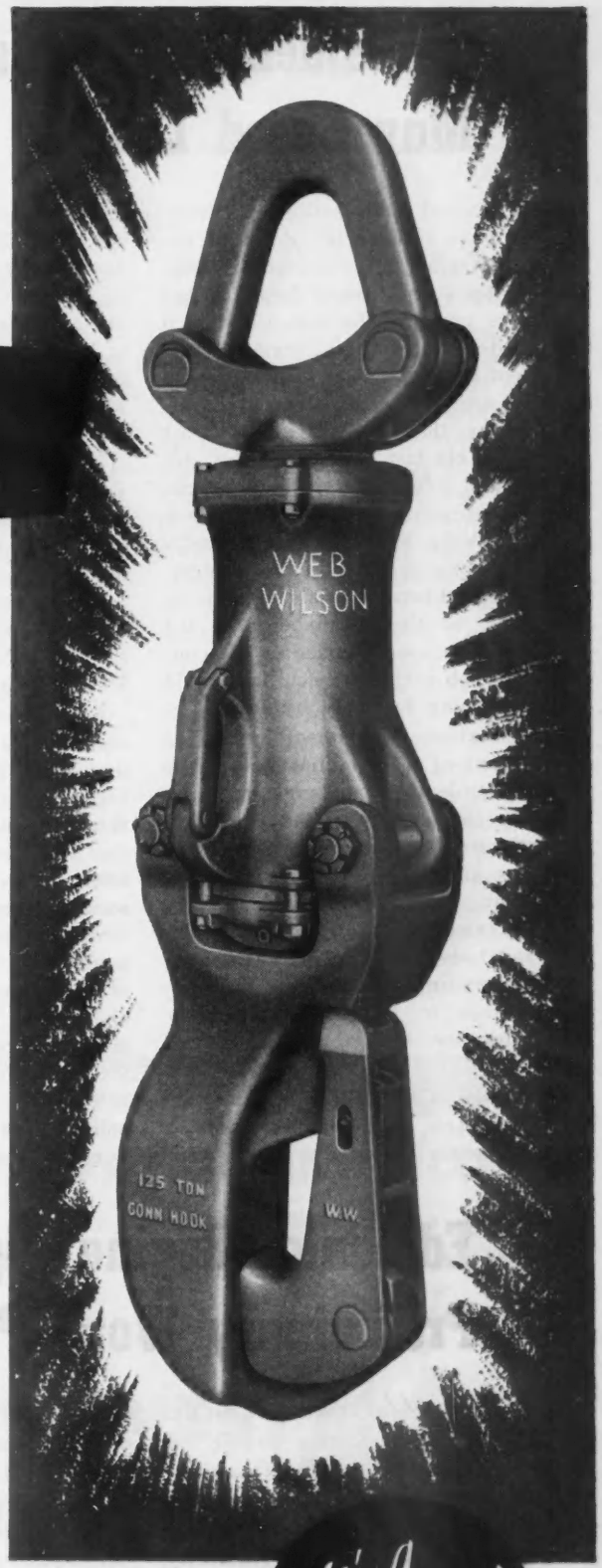
ASSURES HIGHEST OPERATIONAL EFFICIENCY COMBINED WITH EXTREME SIMPLICITY AND GREAT STRENGTH

These *new* Web Wilson Connectors are the latest improvement in this type of oil field equipment. Important features include the elimination of all load carrying threads, an oil-cushioned plunger action, anti-friction roller thrust bearings, an 8-point locking mechanism and extreme simplicity. Can be used as a connector only or a combination connector with hook.



- **Simplicity of design means lower initial cost and fewer and less costly repairs.**
- **Elimination of load carrying threads means greater strength and longer service life.**
- **Connector length is held to a minimum to give greatest operating space in the derrick.**
- **Plunger and bearing operate in an oil bath which provides positive lubrication and a controlled hydraulic action for the spring—an exclusive Web Wilson feature.**
- **Extremely simple 8-point locking device provides adequate adjustment—consists of only three parts.**
- **All parts are magnafluxed and thoroughly tested to assure perfection of quality.**
- **Web Wilson connectors are available in 75, 125, and 300 ton capacities with a 4 to 1 safety factor.**

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WEB WILSON *Oil Tools*

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Presidential Endorsement May Speed Loan to Mexico

Long-awaited intervention by President Truman is expected to speed the granting of a Mexican oil loan. Truman made a public statement June 16 that he favors granting the loan to Mexico for oil development. Previously the President had announced that he would endorse such a loan if it were recommended by the proper government agencies. This last statement goes still further, and it is understood that Truman has pressured Acting Secretary of State Webb to hurry recommendation on the matter. Webb called a meeting of cabinet-level officials to seek an agreement on the justifiability of the loan and its amount, and after the conference Webb declared a decision would be forthcoming probably by July 1.

The Mexican government has asked for a grant of $203 million to finance several petroleum development projects, including construction of the Tehuantepec Isthmus pipe line, modernization of refineries and the purchase of drilling equipment. Antonio J. Bermudez, director of Mexico's state oil monopoly, Pemex, spent several weeks in Washington this year waiting settlement of the loan, but returned to Mexico when negotiations for the line of credit bogged down.

Meanwhile, CIMA (Contratistas Independientes Mexico-Americanos) a company newly formed by Edwin Pauley, American Independent Oil Company, and Signal Oil Company, is preparing to start an underwater search for oil off the Gulf Coast of the Tehuantepec Isthmus. Five ships were assembled at Vera Cruz to conduct the operations, first offshore work ever attempted in Mexico.

The vessels will operate off the coasts of southern Vera Cruz, Campeche and Tabasco. The ships will handle offshore drilling operations as well as transport equipment for test wells on shore in isolated coastal regions. Pauley says the American company is prepared to spend up to $5 million in test drilling during 1949. The 1950 budget, he said, will total $100 million.

Pauley explains that he is acting as an individual in the first operations, but that Ralph K. Davies, head of American Independent, and Samuel Mosher, president of Signal Oil, had agreed to share the financial risk of tidelands exploration and to lend equipment and technicians from their companies. Pauley said a party of 60 men would begin work, "and we will put another party of 60 to work just as soon as we begin drilling our first well." He added: "We may work out as far as nine miles from the coast. We are limited to seven structures in the area assigned to us, but an unlimited number of wells may be drilled in each structure where we find oil."

Edmonton-Regina Pipe Line Preliminary Work Proceeds

Ground survey and other work on the 450-mile Edmonton-Regina crude oil line is proceeding as rapidy as possible, according to Dr. O. B. Hopkins, newly appointed president of the Interprovincial Pipe Line Company, Ltd. Authority of the board of transport commissioners to construct the line has been given.

Air mosaics have been taken and studied to determine the best route, Dr. Hopkins said. The line will take a fairly direct course avoiding lakes, towns and other obstacles. Ground survey parties will work at several points along the line for greater speed.

"The primary objective of the line is to help obtain a wider market for Alberta crude as soon as possible," Dr. Hopkins said. "This objective can only be attained by keeping transportation cost to a minimum and this in turn can only be done by construction of a pipe line along the most direct route possible in the direction of ultimate markets.

"Completion of the line to Regina will not expand the present market for Alberta crude as the prairie area is already saturated and crude is moving beyond Regina by tank car.

"Imperial considers the Edmonton-Regina line a 'first step' towards wider markets and is now studying extension of the line from Regina to the Great Lakes."

Before this year no Dominion legislation govering interprovincial pipe lines existed, but at the last session of the Canadian Parliament a federal Pipe Lines Act and a special act incorporating the Interprovincial Pipe Line Company were passed. This legislation gives the company authority to build interprovincial oil pipe lines. The right is subject to approval of the board of transport commissioners. The decision of the transport board sanctions the first Canadian pipe line under the new Dominion legislation.

Officers of the Interprovincial Pipe Line Company in addition to Dr. Hopkins, are: vice president and director, F. G. Hall; secretary, R. D. Murray; treasurer, K. A. Henderson; directors, A. E. Halverson, J. R. White, C. D. Crichton and R. B. Burgess. All are officials of Imperial Oil which is sponsoring the Interprovincial Pipe Line Company. The new company has an authorized capital of $200 million.

Record Bonus Paid for Alberta Oil Rights Lease

A new record for land prices was set when Amerada Petroleum Corporation paid the Alberta government a bonus of $3,223,320 for a lease on the oil rights on Section 16, or 640 acres, in the discovery township at Redwater.

The previous high was $3,153,491 paid by Royalite on February 15 for the rights on Section 15, east of the Amerada property.

The provincial government will receive its customary lease fees and the usual one-barrel-in-eight royalty on oil produced from the section of land purchased by Amerada. The cash sum is just a bonus.

Section 17, immediately to the west of 16, is being developed by Western Minerals, the Bransdall-Seaboard-Honolulu group. Its first well in the northeast corner logged exceptionally high. This, along with the high logging of the Royalite wells, indicates that the Amerada section is at the top of the structure.

Government and Consultants Confer on Dominican Refinery

Conferences are under way between officials of the Dominican Republic and International Industrial Consultants, S.A., regarding the starting of construction on a new $15 million oil refinery in that country.

The proposed refinery is scheduled for a capacity of 25,000 barrels of refined products. While the primary purpose of the refinery is to reduce production costs for Dominican industry relying chiefly on oil for fuel, the new plant is expected to offer a simultaneous contribution to hemispheric defense by broadening the Caribbean refining potential. It is expected that the refinery will be completed within two years. Contracts between the government and the consulting firm were signed in April.

Po Valley Discovery May Lead to Significant Production

A new oil discovery in northern Italy indicates that the Po Valley may become a producing field of real signficance for Western Europe. The discovery was made June 8 during a recompletion of an old test well southeast of Milan, near the village of Cortemaggiore on the outskirts of Piacenza. Oil was found at 5000 feet, and was described by Italian observers as a "gusher" which spouted 60 feet high. Preliminary tests by Stand-Oil Company (N.J.) field representatives showed the well was flowing 175 barrels a day of light oil and distillates. The quality of the production was called "excellent" by the Italian government which announced that the oil would yield 30 to 40 percent gasoline. The well is also flaring 70,000 cubic litres of gas daily. Further tests have been suspended pending technical difficulties.

So important was the discovery considered by the Italian government that a cabinet communique was issued after a visit to the field by government officials., including Finance Minister Ezio Vanoni. The government statement said that in the area of the Po Valley between the Lombardy and Emilia areas, methane gas deposits appear very important both because of their volume and geographic location, while oil deposits seem very promising."

Oil deposits are said to cover an area of 25 square miles in that region, and there are indications of other reserves in the Po Valley. Italy's crude production, including the present discovery, is now about 375 barrels daily, an increase of 75 percent in the last two years.

Italian authorities estimate that the Cortemaggiore methane deposits are capable of yielding 600,00 cubic meters (21 million cubic feet) of gas daily, a volume that is equivalent to 2½ percent of Italy's internal requirements.

Exploration has been proceeding under direction of the Italian state oil monopoly, AGIP, which is expected to manage and control all production activities. However, a new mining law is now before the Italian government and U. S. concerns such as Jersey Standard are largely waiting on the character of that legislation before stepping up to full scale operations in Italy. Jersey Standard now has one geological party at work in the Po Valley.

Enrico Mattei, AGIP's vice president, terms the Po Valley petroleum deposits so large that when developed "they will radically transform the Italian economy."

High Production Indicated For Austria's Matzen Field

Development of the past few months in Austria's new Matzen field has given rise to estimates that the field will furnish new petroleum production in the amount of from 3 to 4 million barrels a year. This estimate was given by Austrian officials in Vienna after the first well was placed on production by the Soviets about a month ago, producing according to the Russians, about 1000 barrels daily. Three more wells are to go on production within the next two months and the program calls for the drilling of another six wells before the end of this year.

On the basis of present information the operators think production from the new field should be raised to approximately 8500 barrels daily by the end of the year. If such optimistic predictions are borne out it would mean an increase of 50 percent in Austria's total crude oil production over the rate maintained during 1948.

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OIL! TITAN OF THE SOUTHWEST

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NEW AND IMPROVED

Equipment

SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

180—Self-Priming Pumps

This item supplements Marlow Pumps data as shown on page 2504 of Composite Catalog.

Design changes on 26 basic sizes of self-priming centrifugal pumps include a new cover plate engineered for increased strength, flanged suction and discharge connections and improved suction check valve.

Included in the new line are electric horizontal long-coupled and vertical and horizontal close-coupled models, portable and stationary engine-driven models and belt-driven models. All pumps in the line have the "diffuser" method of priming in which the design of the pump itself enables it to prime automatically. The pump contains no by-pass valves or other mechanical devices. It will handle clear water, corrosive chemical solutions, "dry" aromatic compounds, volatile liquids and liquids containing abrasives. They will pump liquids with viscosities up to 5000 Saybolt second units.

The motor-powered long-coupled (Type [illegible]) models in the line cover capacities, and head ranges of 1½ to 10 inches, 15 to [illegible] gallons per minute and 15 to [illegible] feet, respectively. These pumps are standard in cast iron or welded steel and many are available in other metals for special requirements. Many models are made with either flanged or screwed suction and discharge connections. Motors are from ½ to 60 horsepower and are mounted with the pump on welded steel frame, or on wheel mounting where portability is desired.

For additional information, write Marlow Pumps, Ridgewood, N. J., *referring to* WORLD OIL *item* 180.

changing operating conditions. Each hub has two keyways.

For additional information, write Fairbanks, Morse & Company, 600 South Michigan Avenue, Chicago 5, *referring to* WORLD OIL *item* 181.

182—Bridging Plug

This item supplements McCullough Tool Company data as shown on pages 2557-2584 of Composite Catalog.

A one-piece, ductile aluminum alloy, expansion-type bridging plug has simplicity, positive action, greater pipe clearance and a 90 minute or less drilling out speed.

Loose parts, such as rubber packers, springs, cast iron, steel rings and slips, are eliminated.

To operate the device, the entire unit—sinker bar, setting tool, and bridging plug—is lowered to the correct setting depth on an electric wire line. The cap is then fired electrically from the surface, which sets off the charge expanding the plug against the pipe wall. The operator can hear the charge, as it is fired, by means of a special sonic device in the service truck. A pull upward on the line releases the setting tool from the plug. The setting tool is then pulled up 15 to 20 feet and set back down, to check the plug for location. A diamond point bit on a string of tubing will eliminate the plug in 60 to 90 minutes.

Designated as Type "B," the plug is available for 4½-, 4¾-, 5-, 5½-, 5¾-, 6⅝-, 7-, and 8⅝-inch casing.

For additional information write McCullough Tool Company, 5820 South Alameda Street, Los Angeles 11, *referring to* WORLD OIL *item* 182.

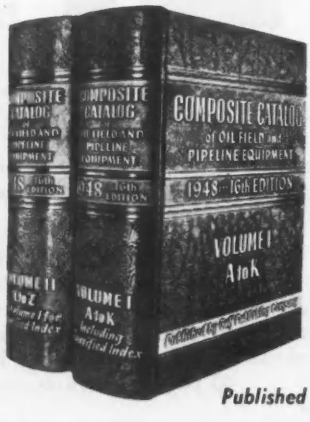
WORLD OIL

New Equipment described in WORLD OIL now have direct reference tie-ins like these with manufacturers' pre-filed catalogs in your Composite Catalog

Composite Catalog and World Oil have teamed up to bring you the most complete buying information on oil field and pipe line equipment at the time it is made available by the manufacturers.

Now, when any of the 462 catalogers in Composite Catalog introduces a new or improved product it is described in the *New and Improved Equipment Department* of World Oil. Not only does the description provide you supplementary information on the item but a direct reference tie-in is made to the manufacturer's data in the Composite Catalog. When additional information or prices are desired you are invited to write direct to the company. For this purpose a mailing address is shown at the end of each description.

Thus, products of Composite Catalog catalogers take on a new and important usefulness for you when described in World Oil. New equipment of the relatively few manufacturers not cataloging in Composite Catalog will continue to be described in World Oil as a part of this expanded editorial service for oil country buyers.



THE UNIVERSAL EQUIPMENT GUIDE FOR OIL COUNTRY BUYERS

Published by WORLD OIL

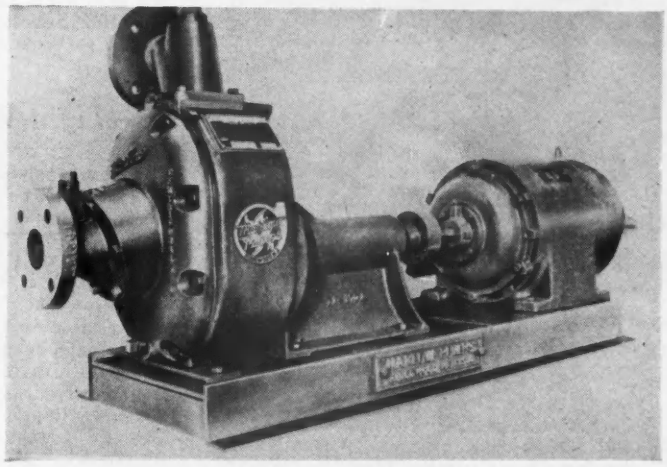
CHECK THE NEW AND IMPROVED EQUIPMENT DESCRIBED IN THIS ISSUE OF WORLD OIL

NEW AND IMPROVED Equipment SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

180—Self-Priming Pumps

This item supplements Marlow Pumps data as shown on page 2504 of Composite Catalog.



Design changes on 26 basic series of self-priming centrifugal pumps include a new cover plate engineered for increased strength, flanged suction and discharge connections and improved suction check valve.

Included in the new line are electric horizontal long-coupled and vertical and horizontal close-coupled models, portable and stationary engine-driven models and belt-driven models. All pumps in the line have the "diffuser" method of priming in which the design of the pump itself enables it to prime automatically. The pump contains no by-pass valves or other mechanical devices. It will handle clear water, coolants, chemical solutions, "dry" aromatic fluids, volatile liquids and liquids containing abrasives. They will pump liquids with viscosities up to 500 Saybolt second units.

The motor powered long-coupled (Type EL) models in the line cover sizes, capacities, and head ranges of 1½ to 10 inches, 15 to 3500 gallons per minute and 15 to 170 feet, respectively. These pumps are standard in cast iron or welded steel and many are available in other metals for special requirements. Many models are made with either flanged or screwed suction and discharge connections. Motors are from ½ to 60 horsepower and are mounted with the pump on welded steel frame, or on wheel mounting where portability is desired.

For additional information, write Marlow Pumps, Ridgewood, N. J., *referring to* World Oil *item* 180.

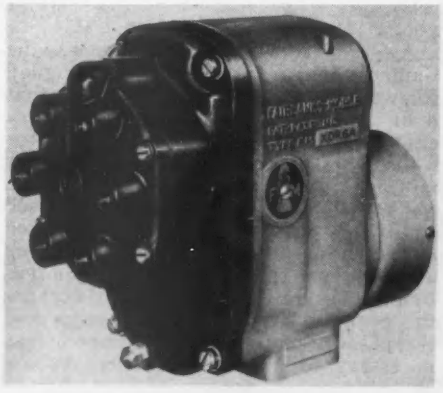
181—Magnetos

This item supplements Fairbanks, Morse & Company data as shown on pages 1261-1268 of Composite Catalog.

Longer life breaker mechanism, larger bearings, improved magnetic rotor and improved timing facilities on the four cylinder units are claimed for a new line of Super Spark magnetos. The line includes magnetos for 1, 2, 4 and 6-cylinder small, medium and heavy duty engines and power units.

A new universal impulse coupling, known as the type UE, has been developed to use with one extra coupling hub to make hundreds of magneto specifications. For example, by using the UE Impulse Coupling, NT2563-C, built with the U2563 hub, a coupling can be made for adjusting to lag angles of 10, 20, 30, 40 or 50 degrees.

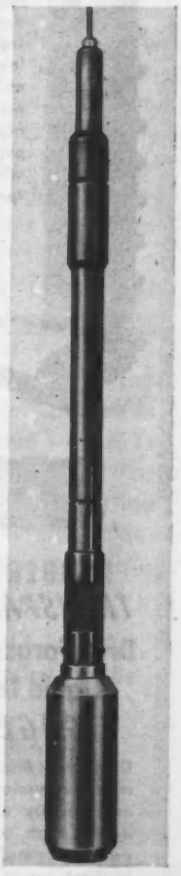
The coupling also provides for the adjustment to various lug angles to meet changing operating conditions. Each hub has two keyways.



For additional information, write Fairbanks, Morse & Company, 600 South Michigan Avenue, Chicago 5, *referring to* World Oil *item* 181.

182—Bridging Plug

This item supplements McCullough Tool Company data as shown on pages 2557-2584 of Composite Catalog.



A one-piece, ductile aluminum alloy, expansion-type bridging plug has simplicity, positive action, greater pipe clearance and a 90 minute or less drilling out speed.

Loose parts, such as rubber packers, springs, cast iron, steel rings and slips, are eliminated.

To operate the device, the entire unit—sinker bar, setting tool, and bridging plug—is lowered to the correct setting depth on an electric wire line. The cap is then fired electrically from the surface, which sets off the charge expanding the plug against the pipe wall. The operator can hear the charge, as it is fired, by means of a special sonic device in the service truck. A pull upward on the line releases the setting tool from the plug. The setting tool is then pulled up 15 to 20 feet and set back down, to check the plug for location. A diamond point bit on a string of tubing will eliminate the plug in 60 to 90 minutes.

Designated as Type "B," the plug is available for 4½-, 4¾-, 5-, 5½-, 5¾-, 6⅝-, 7-, and 8⅝-inch casing.

For additional information write McCullough Tool Company, 5820 South Alameda Street, Los Angeles 11, *referring to* World Oil *item* 182.

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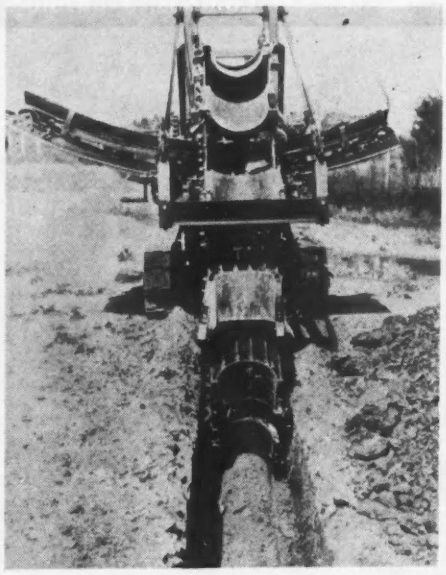
NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

183—Pipe-Stripping Buckets

This item supplements The Cleveland Trencher Company data as shown on page 1069 of Composite Catalog.



Buckets for stripping pipe for take-up and repair have been designed for installation on the digging wheel of Cleveland trenching machines.

Offered in two sizes, 16- and 22-inch, the buckets strip pipe from four to 16 inches in diameter. They permit excavating down to and along both sides of the pipe to at least its horizontal diameter, thus completely freeing the pipe for take-up with no bending damage due to earth bind.

Contour of the stripping buckets facilitates their following and staying on the line despite sidebends. Because the buckets are practically concentric with the pipe being exposed, danger of tooth or rooter damage is diminished.

For additional information, write The Cleveland Trencher Company, 20100 St. Clair Avenue, Cleveland 15, *referring to* WORLD OIL *item* 183.

184—Flow Valve

This item supplements Camco, Inc., data as shown on pages 900-901 of Composite Catalog.

A giant flow valve, known as the Camco Slugger, is especially designed for wells whose fluid level is so low that it is impossible to obtain satisfactory efficiency using standard valves, and for wells where high-pressure gas is either not available or prohibitively expensive.

The Type "D" flow valve has increased gas by-pass area which allows increased rate of flow into the tubing for a given available gas pressure. This large gas by-pass assures lifting efficiency because the port capacity is adequate to permit the passage of the large volumes of gas necessary to maintain sufficient tubing pressure under the load to keep up lifting velocities.

The "Snap action" of the valve in opening and closing prevents loss of efficiency through "bleeding" of gas.

The slug of fluid in the valve is now followed by a broken-up spray. Large fluid passage permits use of much lower gas pressures; thus gas lift installations using the valve can be employed in fields formerly considered suitable only for pumping. Pressures as low as 150 pounds can be used.

For additional information, write Camco, Inc., 1108 Scanlan Building, Houston, *referring to* WORLD OIL *item* 184.

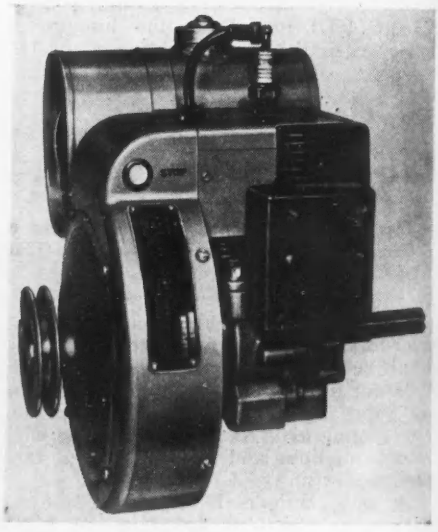
185—Light-Weight Engine

This item supplements Homelite Corporation data as shown on pages 1736-1737 of Composite Catalog.

Weighing only 19 pounds complete, a new air-cooled four horsepower gasoline engine uses die-cast aluminum alloys for all major castings.

Two-cycle design permits a minimum number of moving parts. There are no exhaust valves, and only one rotary intake valve which is self-seating and requires no adjustment. Engine speed is controlled by a built-in governor which is part of the rotary intake valve. Float-feed carburetor is furnished with or without throttle. The engine has double-row ball bearings on crankshaft and connecting rod, needle bearing on wrist pin, and high-tension Wico magneto.

Designed for any industrial application where light weight and compact size are important, the engine can be used either horizontally or vertically. It develops four horsepower at 4000 revolutions per minute and three horsepower at 3000 rpm. Over-all dimensions are 9½



inches long x 11½ inches wide x 13 inches high.

For additional information, write Homelite Corporation, Riverdale and Chester streets, Port Chester, N. Y., *referring to* WORLD OIL *item* 185.

MY-LO-JEL

THE New MAGCOBAR STARCH LOWERS WATER LOSS AND KEEPS IT LOW!

Magcobar MY-LO-JEL is an improved pregelatinized drilling mud starch in the form of a free flowing powder which can be added directly to the mud through a hopper mixer. It provides positive control of the filtration properties of mud even in the presence of salt, anhydrite and other contaminants. MY-LO-JEL is a blended starch that is especially processed to produce a quick acting, tough and chemically stable plugging agent to inhibit filtration of mud. Thus, it not only lowers the water loss, but keeps it low.

MY-LO-JEL is economical to use. Two to four pounds per barrel of mud is all that is needed to impart the low water loss desired of most muds. It has a stabilizing effect on mud which often greatly reduces the cost of maintenance while drilling. Low water loss muds made with MY-LO-JEL are doing much to hold down the present day cost of drilling by eliminating strings of protection casing, preventing delays due to reaming, hole trouble and fishing jobs.

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- If a special type of packer, valve or other equipment is needed on location in a hurry—fly it by Clipper Cargo. You will minimize costly shutdowns.

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PAN AMERICAN WORLD AIRWAYS

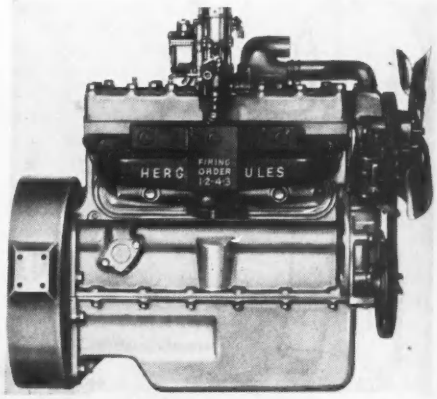
PAA

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

186—Gasoline Engines

This item supplements Hercules Motors Corporation data as shown on page 1719 of Composite Catalog.



For general purpose power application, three new four cylinder heavy duty gasoline engines, designated Series JX4, are equipped with five main bearings and counterbalanced crankshaft.

The high speed, heavy duty engines are available in Model JX4E, which has 3½-inch bore x 4¼-inch stroke, 164-cubic inch displacement; JX4C, 3¾-inch bore x 4¼-inch stroke, 188-cubic inch displacement; and JX4D, 4-inch bore x 4¼-inch stroke, 214-cubic inch displacement.

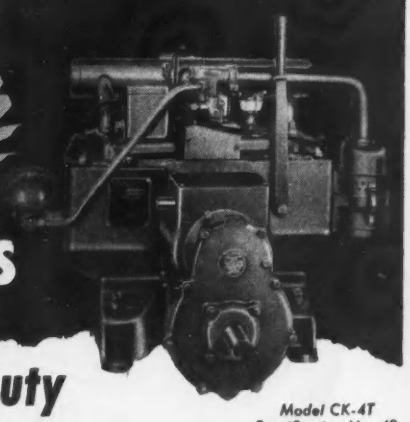
A positive oil seal at front and rear of the crankshaft prevents oil escaping at these points. Main bearings are brass backed, babbit lined, and connecting rod bearings are steel backed, copper-lead lined and lead plated. In the cylinder head, combustion chambers are partially machined.

The pistons, of special alloy aluminum, are each equipped with four rings above the piston pin. Exhaust valves have austenitic heads welded to hardened nickel steel stems to offer resistance to burning and oxidation and maintain valve head strength at elevated temperature.

Full length water jackets are provided around each cylinder. Packless seal water pump has positive gear drive.

For additional information, write Hercules Motors Corporation, Market and 11th Streets, Canton, O., *referring to* WORLD OIL *item* 186.

ONAN "CK" Oilfielder ENGINES



Built for Continuous Duty on Tough Pumping Jobs!

Do you have a job for a 5½ HP roughneck? Here's a dependable 1000-inch-pound torque engine that will do a job for you day-in and day-out with minimum maintenance and attention. No cooling problem because it's air-cooled. Little or no sludging. Has features of an engine many times its size. Smoother-running because of its twin-cylinder, horizontally-opposed engine.

Full pressure lubrication by gear-type oil pump. Runs on either gas or gasoline. Check with your supply house or write. ONAN OILFIELDER ENGINE—5½ HP. ONAN ELECTRIC PLANTS—A.C.: 350 to 35,000 watts. D.C.: 1200 to 15,000 watts. Gas-gasoline and Diesel models.

D. W. ONAN & SONS INC.

5354 Royalston Avenue • Minneapolis 5, Minnesota

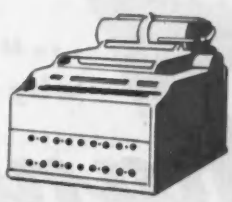
Model CK-4T
Specification No. 49
5½ HP (API)

- 1000-inch-pound torque
- 5½ HP continuous duty (by API formula) • 960-ft. piston speed • 525 PTO shaft speed through 4.1 gear reduction
- Over-center dry disc clutch
- 4-quart oil sump • Air-cooled by axial-flow blower.

Onan PRODUCTS **ENGINES & ELECTRIC PLANTS**

The Schlumberger Electrical Log is the most accurate record of electrical measurements on a formation in a bore hole.

• This Schlumberger Camera and its companion instruments are designed to record a log of true resistivity values with reference to a known fixed zero. When you call Schlumberger, you get the best!



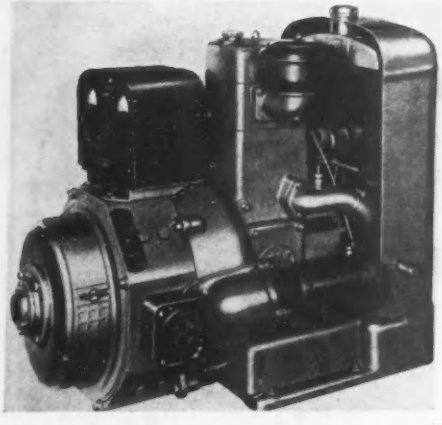
SCHLUMBERGER
WELL SURVEYING CORP.
HOUSTON, TEXAS

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

187—Small Diesel

This item supplements Fairbanks, Morse & Company data as shown on pages 1261-1268 of Composite Catalog.



Combinations as a power unit, a three-kilowatt alternating or direct current generator set, or as a marine propulsion unit with reduction gears, are available with a new small diesel engine rated at 5¼ horsepower at 1800 revolutions per minute.

The new engine is of the heavy duty vertical type, four-stroke cycle, solid injection, with full pressure lubrication. It has removable cylinder sleeve, removable cylinder head containing valves and combustion chamber, accessible injection pump, and cast alloy iron crankshaft.

Radiator of heat exchanger cooling can be furnished with any combination of the Model 45 engine. All engines are equipped with 12-volt electric starting or with hand crank. Manual starter is especially equipped with 2:1 cranking device.

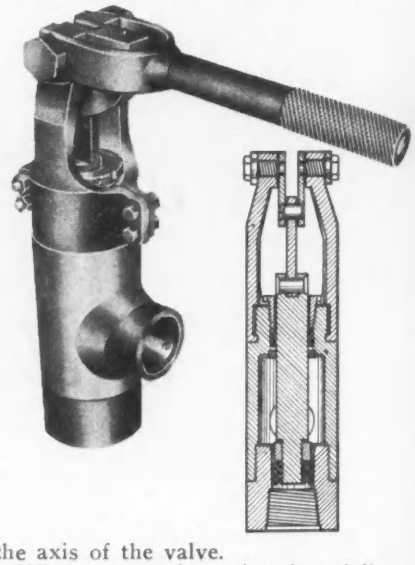
For additional information write Fairbanks, Morse & Company, 600 South Michigan Avenue, Chicago 5, *referring to* WORLD OIL *item* 187.

188—Release Valve

This item supplements Drilling Equipment Manufacturing Company data as shown on page 1157 of Composite Catalog.

Simple construction of a new slush pump release valve permits rapid opening under high pressure conditions without incurring danger of injury to the operator.

The valve provides a positive means for sealing the fluid under high pressure, and is not subject to erosion and cutting action ordinarily caused by leakage of high velocity abrasive fluid.



Valve structure requires no adjustment of linkage. Lever arm may be positioned in any radial direction with respect to the axis of the valve.

When open, the valve has full unrestricted flow.

For additional information, write Drilling Equipment Manufacturing Company, P. O. Box 4272, Oklahoma City 9, *referring to* WORLD OIL *item* 188.

... another reason why drillers prefer

Standco NO-SMOKE BRAKE LINING

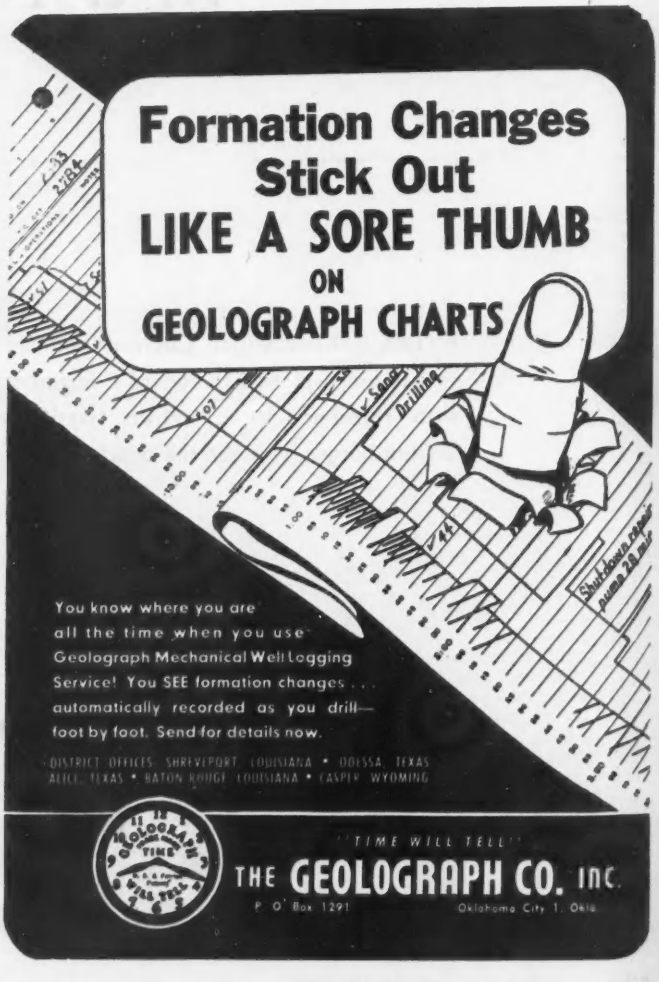
Standco Brake Blocks are made of cabled cords of long fibre asbestos — woven solid and reinforced with bronze wire to prevent pulling loose on the belts. They will not burn or smoke or score brake rims.

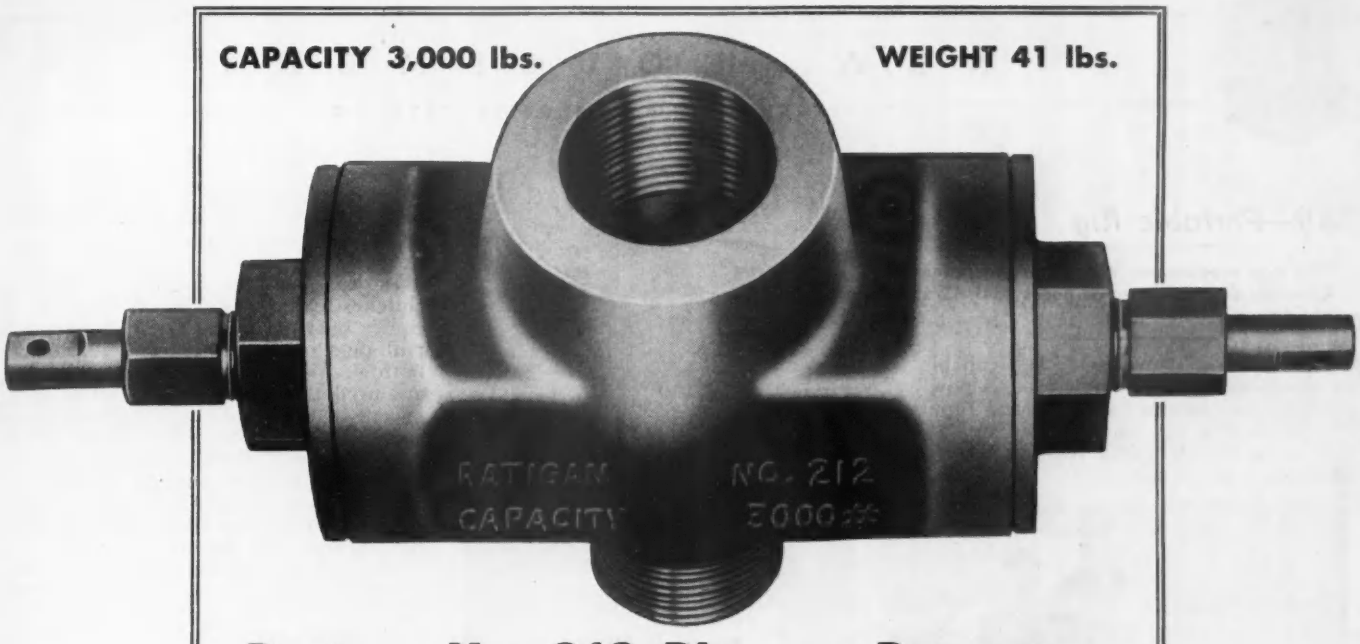
More deep wells have been drilled with Standco than with all other blocks combined. It's your answer for low-cost hole-making.

STANDCO BRAKE LINING COMPANY

Factory and General Offices

2701-2801 Clinton Drive — Houston, Texas

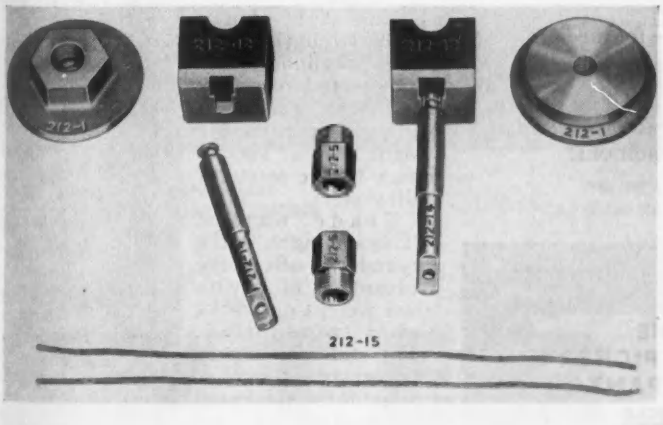

Formation Changes Stick Out
LIKE A SORE THUMB
ON
GEOLOGRAPH CHARTS
You know where you are all the time when you use Geolograph Mechanical Well Logging Service! You SEE formation changes . . . automatically recorded as you drill—foot by foot. Send for details now.
DISTRICT OFFICES: SHREVEPORT, LOUISIANA • ODESSA, TEXAS
ALICE, TEXAS • BATON ROUGE, LOUISIANA • CASPER, WYOMING
"TIME WILL TELL"
THE GEOLOGRAPH CO. INC.
P. O. Box 1291 — Oklahoma City 1, Okla.



Ratigan No. 212 Blowout Preventer

FEATURES EASY, FAST-CHANGING RETRACTABLE RUBBERS . . . . SIMPLY UNSCREW PLUGS AT EACH END

The Ratigan No. 212 Blowout Preventer is an improved unit with new type retractable rubbers, which can be changed more rapidly. Also, it has new tapered plugs which eliminate need for gaskets. To change rubbers it is only necessary to unscrew the tapered plugs at each end and replace the old rubbers with new ones . . . see parts illustration below.



The No. 212 is designed for maximum safety and convenience in operation and has a capacity of 3,000 lbs. yet weighs only 41 lbs. It is also used for swabbing or running rods in wells that head or flow in the course of operation.

It is manufactured in 2½" and 3" sizes. The 2½" size is supplied both plain and upset, and the plain can be furnished in double female, but if male and female are required, a short nipple can be used to accomplish this. The 2½" upset can be made in male and female or double female. The 3" size is supplied male and female only; however, the male connection easily can be converted to female by installing a 3" collar, thus making a double-female unit. Two of these blowout preventers of the same size, with a nipple of any required length in between make a very efficient unit for swabbing.

Ratigan's complete line of oil well pumping equipment is illustrated and described in the latest edition of the Composite Catalog.

J. P. RATIGAN, Inc.

1213 South Santa Fe Avenue, Los Angeles 21, California

Ratigan Products Are Sold Through Leading Supply Stores

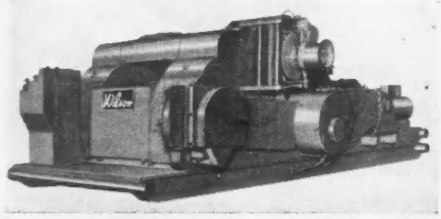
NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

189—Portable Rig

This item supplements Wilson Manufacturing Company data as shown on pages 4341-4376 of Composite Catalog.

A rotary rig 12 feet wide and capable of being moved in a single load is powered by two engines with a total input of 500 horsepower, and is rated to 7500 feet with 4½-inch drill pipe or 9000 if 3½-inch pipe is used.



Arrangement of cathead shaft permits either plain or spinning line catheads on the driller's side and either automatic or breakout catheads on opposite position.

In case of air failure, low speed clutches can be locked in position to come out of hole. One engine will pull pipe out of hole from a 7500-foot bottom. Wichita air-tube disc clutches are used throughout the Roadair Giant except in the drums and on the reverse gear. The air-tube disc clutch affords remote control, small manual pressure for full torque, and smooth starting features. A greater torque capacity is given in the air-tube disc clutch than is possible with radial type air clutches.

Internal expanding shoe-type friction clutch is used on both the high and low speed in the drum. Built inside the brake ring, the clutch is water-cooled with the same operation used in cooling the brake. Except for the clutch spider and the clutch sprockets, all parts of drum clutches are interchangeable.

Brakes have long equalizer and single nut adjustment. Friction latch on the hand brake lever makes it possible to set and lock this brake at any desired position.

Drum is full 42-inch width. Clutch speed can be changed while drum is in motion.

For additional information, write Wilson Manufacturing Company, P. O. Box 329, Wichita Falls, Texas, *referring to* WORLD OIL *item* 189.

Bottom Water is a drain on profits

Eagle Lead Wool

shuts out Bottom Water!

To insure an uninterrupted flow of oil from your wells, banish bottom water with economical Eagle Lead Wool. This finely stranded metallic wool, tamped around the hole, effectively seals every crack, becomes a permanent, non-corrosive plug. Packed in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle Wire Containers sized to fit all casings.

These 3 Eagle Bearing Metals meet most requirements

Eagle Dreadnaught — for extreme speed and heavy-duty conditions.

Eagle Outlasta — for medium speed and average-load conditions.

Eagle Durable—for low speed and light-duty conditions.

EAGLE LEAD WOOL

Seals off Bottom Water— keeps 'em flowing!

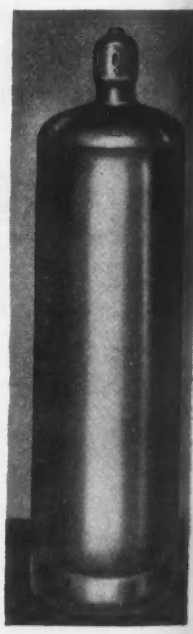
THE EAGLE-PICHER COMPANY

EAGLE Since ED 1843 PICHER

Cincinnati . East St. Louis Chicago . Dallas . Kansas City

190—Propane Cylinders

This item supplements Harrisburg Steel Corporation data as shown on pages 1700-1701 of Composite Catalog.



New light-weight, high-strength propane cylinders of 100-pound capacity and tare weight of only 72 pounds are made of a special high tensile strength alloy steel.

Trade named "Lite-Weight," the cylinders offer the advantage of having less weight on trucks when transported. The smooth, corrosion-resistant steel is of uniform thickness throughout.

Cylinders are supplied in any quantity desired, with or without pressed steel caps, with valves inserted, if desired.

For additional information, write Harrisburg Steel Corporation, Simpson and Wear Streets, Harrisburg 8, Penn., *referring to* WORLD OIL *item* 190.

YELLOW ENGINES
built to handle big jobs

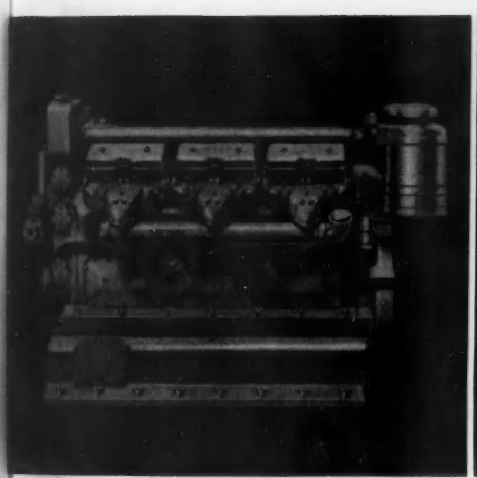
Oil men in every field have learned from long experience that they can always depend on "those big yellow 'Caterpillar' Engines." They've proved themselves on drawworks, rotaries, power slush pumps, pipeline pumps, well pumps, and a host of other oilfield jobs.

Now you can power your larger rigs with new, bigger "Cat" Engines and "Cat" Electric Sets. In addition to present models, are four great new "Caterpillar" Oilfield Engines, ranging up to 500 horsepower. With four D397 Engines compounded, you have up to 2000 horsepower for hoisting under maximum oil-drilling conditions.

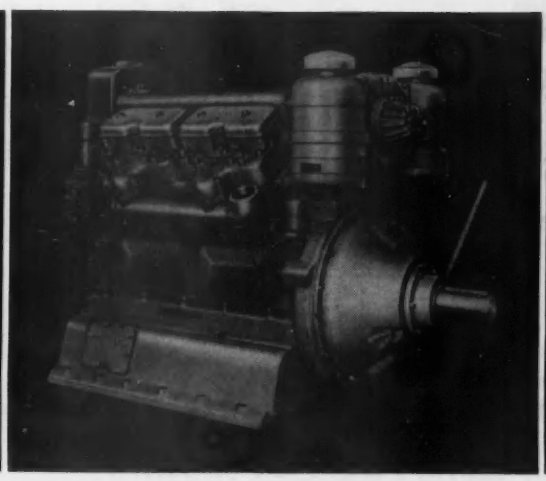
"Cat" Oilfield Engines are built in the world's finest, most modern engine factory. Every engine is built for utmost stamina and long life. Each is given a closely supervised dynamometer run to assure proper break-in and full horsepower output.

When you buy your new oilfield machinery, specify "Caterpillar" Oilfield Engines. Consult your reliable "Caterpillar" dealer about your oilfield power problems.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS



THE NEW 400-HP. D386
"CATERPILLAR" OILFIELD ENGINE



THE NEW 335-HP. D375
"CATERPILLAR" OILFIELD ENGINE

THE NEW 265-HP. D364
"CATERPILLAR" OILFIELD ENGINE

CATERPILLAR

REG. U. S. PAT. OFF.

OILFIELD ENGINES

TRACTORS MOTOR GRADERS

EARTHMOVING EQUIPMENT

CATERPILLAR TRACTOR CO.
Box WO-78, Peoria, Illinois
Send me specifications on the new "Cat" Oilfield Engines and Electric Sets.

Name_____

Address_____

Longer Thread Life
WITH
Jimmie Gray
COMPOUNDS

KANT-GALL TOOL JOINT COMPOUNDS

EXCLUSIVE 500-TON SPECIAL

LONG-LIFE DRILL COLLAR COMPOUND

You can always break the joint when you use Jimmie Gray Compounds! That's because each one is engineered to do certain specified jobs best! You can depend on their thread-protecting film to prevent galling and washouts, too. Satisfaction is assured thru the famous Jimmie Gray money-back guarantee!

SOLD BY SUPPLY STORES EVERYWHERE

FORMERLY STANDARD OIL SALES CO.

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QUICK, ACCURATE RESULTS
LESS EFFORT
Curtin CENTRIFUGES

No. 3420
15 c.c. machine . . .
Cranks and heads interchangeable with 100 c.c. machines.

Simple in design . . . Ruggedly built . . . Requires no special care . . . Great Ratio and throw of crank produce required speed with no strain. Curtin Centrifuges meet all A.S.T.M. Standard Method D-96 and A.P.I. Code No. 25 requirements. Fully descriptive literature upon request.

W·H·CURTIN & CO.

HOUSTON . . . . NEW ORLEANS.

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

191—Diesel Electric Plant

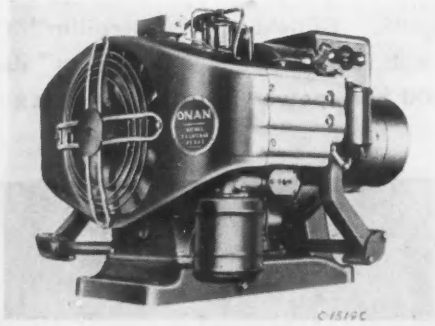
This item supplements D. W. Onan & Sons, Inc., data as shown on pages 3256-3257 of Composite Catalog.

Design of its prime mover, an opposed-two-cylinder, air-cooled diesel engine, eliminates vibration in a new 5000-watt alternating current electric plant.

Adaptable to portable applications, the Model 5DRP is available in 60- or 50-cycle and in all standard voltages.

Standard equipment on the plant includes two six-volt starting batteries, battery cables, hydrometer, mounting rubbers, five-gallon fuel tank, two flexible fuel lines, muffler, two large oil bath air cleaners, primary and secondary fuel filters, two air heaters.

Control panel, mounted over the generator, is equipped with start-stop switch, manifold air-heater switch, high-low battery charge rate toggle switch and charge rate ammeter, reverse current relay, starting solenoid switch and



battery terminals. Remote control stations can be installed within 250 feet of the unit.

The plant has large bearing surfaces and forced pressure lubrication, and uses compression starting.

Dimensions of the unit are 38¾ inches high x 30¼ inches wide x 26⅛ inches high. Weight is approximately 725 pounds, less batteries.

For additional information, write D. W. Onan & Sons, Inc., 3621 Royalston Avenue, Minneapolis 5, *referring to* WORLD OIL *item* 191.

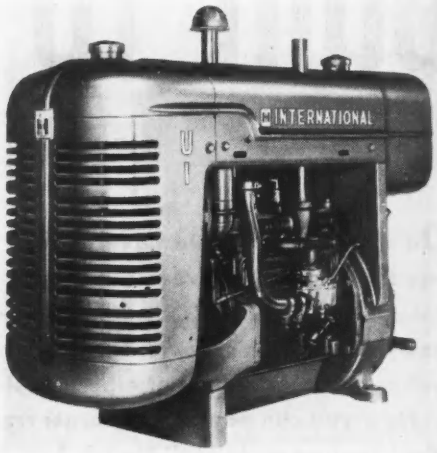
192—16-Horsepower Engine

This item supplements International Harvester Company data as shown on pages 2037-2040 of Composite Catalog.

A new four-cylinder gasoline engine is suitable for a wide range of light duty applications, including powering fans or blowers, oil or water pumps, generators, portable in-plant or outdoor units.

It is available as a stripped engine or with attachments up to a complete power unit, and can be equipped to operate either on gasoline or natural gas.

Stripped, the U-1 delivers a maximum of 16.3 brake horsepower at 2500 revolutions per minute. It develops a maximum of 16 working horsepower equipped with fan, radiator and air cleaner. Overall dimensions of the engine are 26 13/32 inches, length; 16 11/32 inches, width; 25 inches, height. The engine itself



weighs approximately 280 pounds; the complete power unit, 450.

For additional information, write International Harvester Company, 180 North Michigan Avenue, Chicago 1, *referring to* WORLD OIL *item* 192.

DIAMOND CORING

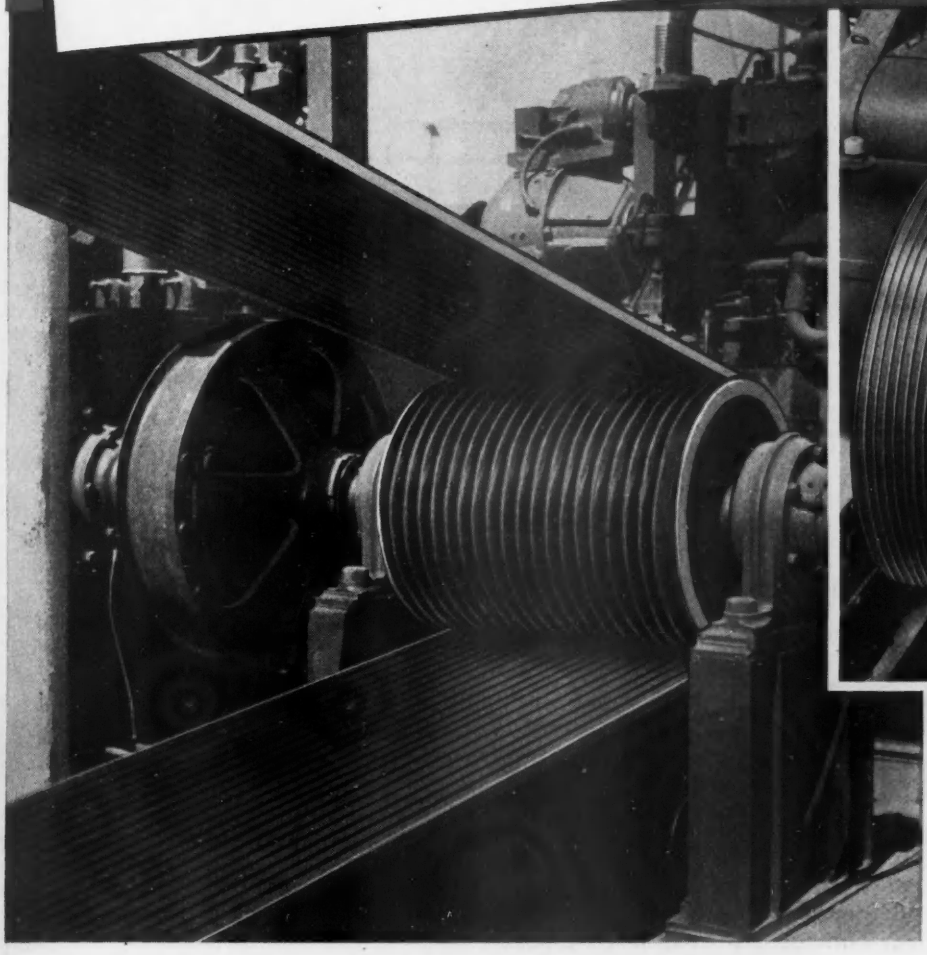
brings. . .
✓ SPEEDIER PENETRATION
and. . .
✓ GREATER RECOVERIES

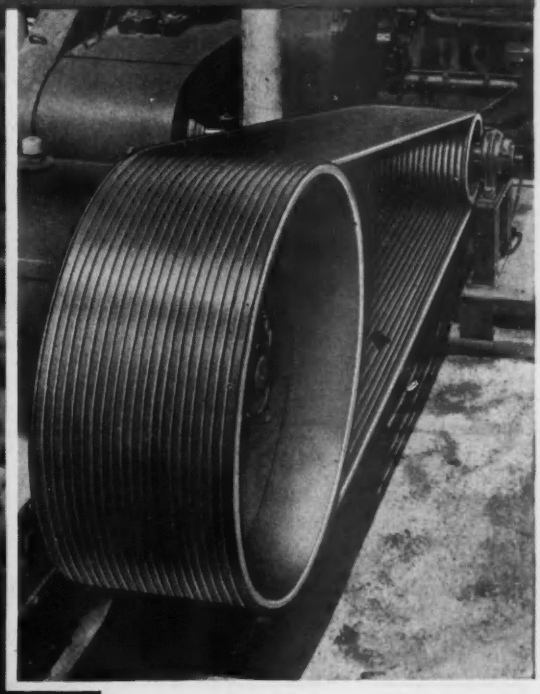
✓ DIAMOND CORE BITS . . . for sale
✓ SPECIAL CORE BARRELS for rent or sale
✓ SERVICE ENGINEERS

DIAMOND OIL WELL DRILLING COMPANY
204 Wemple-Avery Bldg. 110 West Wall
MIDLAND, TEXAS
Phone 2710

RUGGED - DEPENDABLE

DAYTON V-BELTS ARE BUILT WITH RAYON GUTS*





There's no tougher service for V-Belts anywhere than in the oil fields. And Dayton V-Belts will give you more for your money regardless of how you use them.

Because Dayton V-Belts are built to take it. Sand, dust, heat and rain have no effect. They stand up under the most adverse conditions. Raytex Fortified Cords are the reason . . . specially processed Rayon . . . built right in for extra strength.

It's this extra strength that means *minimum stretch, greater flex strength* and *longer, trouble-free V-Belt life* on your oil field drives . . . qualities that result in fewer "take-ups", less maintenance, smoother starting and stopping, far less bearing wear. It's no wonder most oil field men choose Daytons . . . standardize on Daytons.

For on-the-spot stocks of Dayton V-Belts and for field assistance by oil field experts, call or write the *Continental Supply Company, Dallas, Texas.*

V-Belts by **Dayton Rubber**

THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

SERVICE BY **Continental**

OTHER NEW AND IMPROVED *Equipment*

193—Truck

The model YU truck features a safety cab of welded, all steel construction, three-point mounted to permit it to move as an independent unit to relieve the cab structure of strains when traveling over uneven ground.

Greater visibility is provided in the design of the doof and rear cab windows and the windshield. The interior of the cab has wide seats which are adjustable while driving, Cell-U-Suede interior finish for insulation, and an overhead map compartment.

A vacuum operated center differential lock permits locking of the differential, giving positive power to both front and rear axles for climbing steep hills, plowing through mud or sand. The standard five-speed transmission contains helical gears in all forward speeds. Ten speeds forward and two reverse are provided by an optional auxiliary transmission. The YU has a 142-horsepower motor. Torque of the motor is 425 foot pounds. Spiral-bevel ring gears and pinions are provided in both front and rear axles.

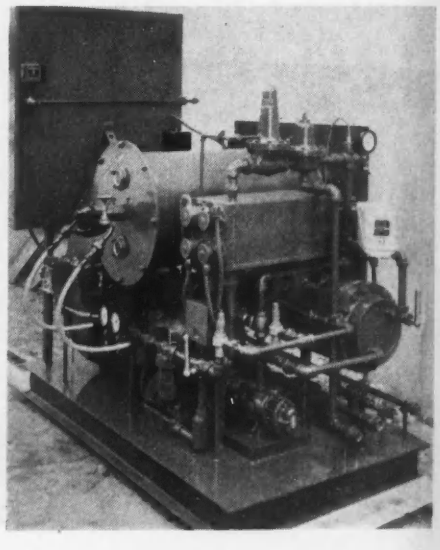
Equipped with a five-yard dump body, the truck has a standard wheelbase of 150 inches, with options up to 182 inches and body space back of the cab from 121 to 190 inches. Side panels of the hood can be lifted for simple servicing, and for major motor overhaul, the hood top may be removed by taking out four bolts. Catwalks of diamond plate construction are provided on the top of each fender and on top of the front skirting.

For additional information write The Four Wheel Drive Auto Company, East 12th and Auto Street, Clintonville, Wis., *referring to* WORLD OIL *item* 193.

194—Automatic Burner

An automatic burner unit comprises a complete system of fuel oil pumping and preheating, fuel oil pressure, and temperature regulating constant differential mechanical atomizing oil units. It is mounted on a rigid steel frame, ready to be bolted to the furnace front plate.

The burner is equipped with a system of electrically actuated fully automatic safety controls consisting of gas-electric ignition, electronic flame failure protection, solenoid dual oil shutoff valve,



steam pressure limit switch, gas pressure cutout switch, low fuel oil temperature cutout switch, and low fire start after each burner shutdown.

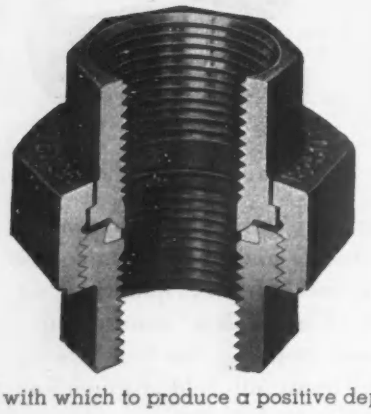
The fan and fuel oil pump are driven by the same motor. The fuel oil pump is a slow-speed, heavy-duty type which takes its drive through the speed reduction gear of the motor.

The fan is fitted with a vaned air inlet control that regulates the amount of air from maximum to minimum fire. The air and fuel oil are synchronized and proportioned by an electric modulating motor. The operation of the modulating motor is controlled by an adjustable steam pressure regulator which maintains a constant desired operating steam pressure within the capacity range of the burner.

The burner is arranged with outlets for connection to the fuel oil storage tank, steam supply, gas supply and electric power supply and the control equipment is mounted on an accessible panel board.

For additional information write Peabody Engineering Corporation, 580 Fifth Avenue, New York 19, *referring to* WORLD OIL *item* 194.

Jefferson Malleable Unions



JEFFERSON'S *EXCEL* unions and union fittings available in brass-to-iron, and iron-to-iron seats. Certified Air Furnace iron used in the EXCEL line is A.S.T.M.-4733-Grade 35018 malleable, having a 53000 lb. Min. Ten.

EXCEL—
250 lb. S.W.P. — 500 lb. C.W.P.

Certified Air Furnace iron produces a constant, uniform, finer grain structure union. This provides a much better iron with which to produce a positive dependable seating surface.

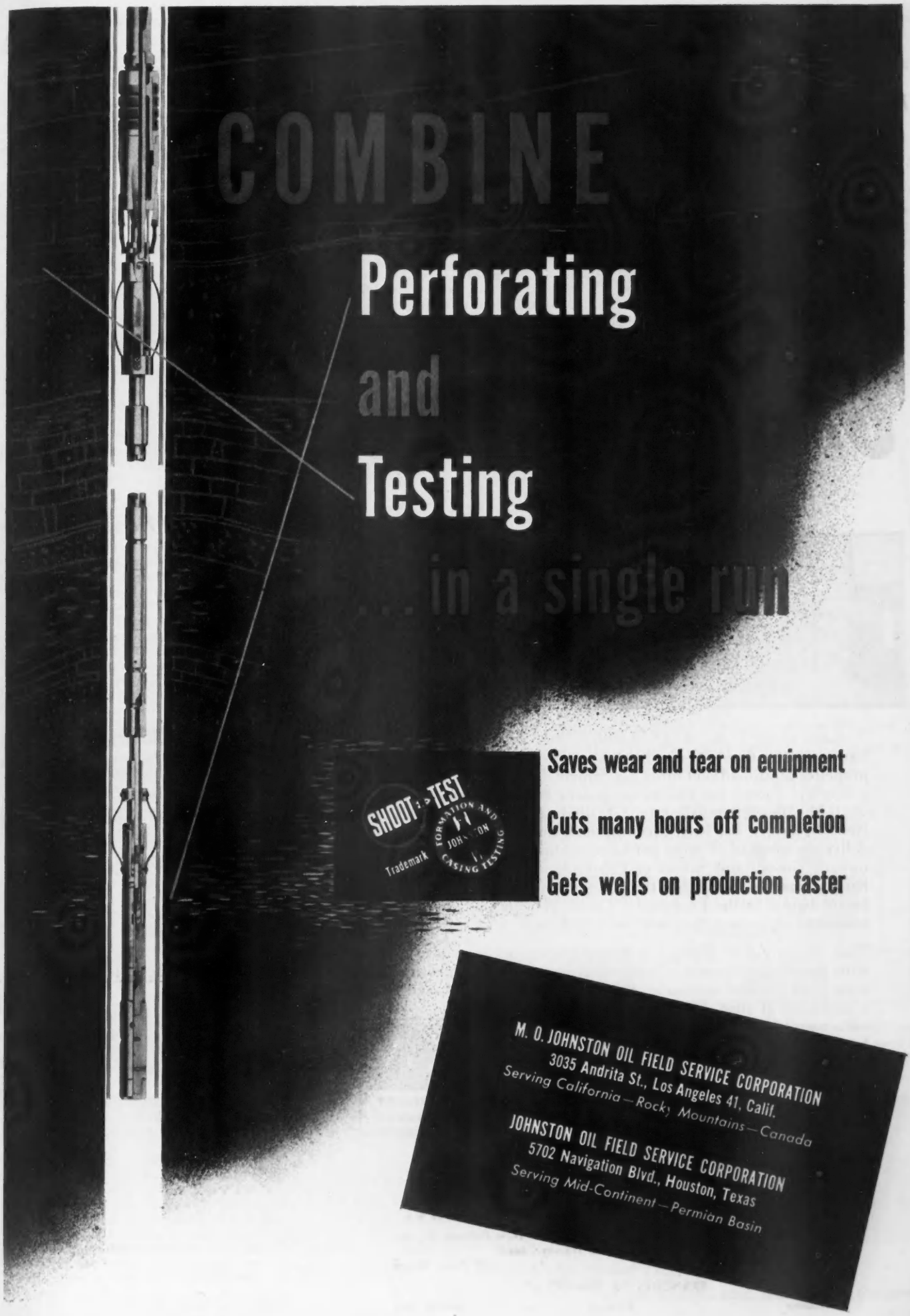
Unions manufactured from this malleable iron give 30% more strength; 50% more impact value; 75% more elongation. Sizes ¼" thru 3".

Obtainable through your jobber

Jefferson Union Company, Inc.

691 West 26th St.,
New York 1, New York

71 Gooding St., Lockport, New York
31 Fletcher Ave., Lexington 73, Mass.


COMBINE
Perforating
and
Testing
... in a single run
SHOOT
TEST
Trademark
FORMATION AND
CASING TESTING
Saves wear and tear on equipment
Cuts many hours off completion
Gets wells on production faster
M. O. JOHNSTON OIL FIELD SERVICE CORPORATION
3035 Andrita St., Los Angeles 41, Calif.
Serving California—Rocky Mountains—Canada
JOHNSTON OIL FIELD SERVICE CORPORATION
5702 Navigation Blvd., Houston, Texas
Serving Mid-Continent—Permian Basin

195—Electronic Pressure Transmitter

Transmission of pressure indications is provided with a Microsen pressure transmitter. Pressure motion is picked up from the tip of a Bourdon tube and by means of the electro mechanical relay, this motion is converted into a stable and accurate direct current signal which can be indicated or recorded with milliampere or millivolt instruments.

Since the electrical output is directly proportional to the movement of the Bourdon tube, it is possible to use uniformly graduated scales.

The case construction permits servicing either the pressure system or the electrical system independently of each other. The case which houses the transmitter is cast aluminum, dust- and vaporproof, with screwed-on covers. A mounting boss integral with the case makes mounting easy.

Standard pressure ranges up to 50,000 pounds are available. The combined resistance of the lead wire and indicator circuit may be any value up to 3000 ohms maximum without affecting the performance of the transmitter.

Operating voltage is 115 volts at 50-60 cycles. Normal voltage variations do not materially influence the final readings. Power consumption is two watts.

For additional information write Manning, Maxwell and Moore, Inc., 11 Elias Street, Bridgeport, Conn., *referring to* WORLD OIL *item* 195.

196—Tubing Head

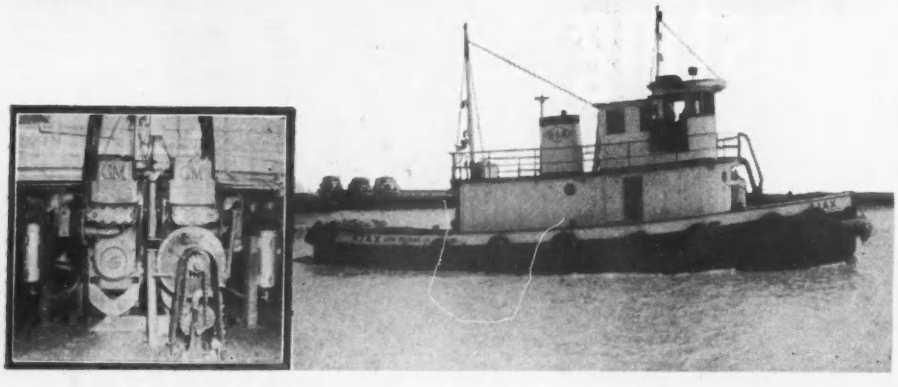
A "steering wheel" on a new forged steel tubing head enables the operator to compress, by hand pressure, the rubber packing mechanism above the slip suspension.

Outlets are electrically welded to the heavy walled mechanical tubing body. The DRH Type 2S tubing head is designed for 3000 pounds per square inch test pressure or 1500 psi cold working pressure. As the head is designed without draft angles, chain tongs can be applied to the lower half of the body below the outlets for application of head to casing.

Packoff seal between casing and tubing is positioned above the slips, permitting replacement of packing without disturbing the string of tubing. Assembled height of the head is 12 inches, and fabricated construction weight is approximately 90 pounds.

For additional information, write Don R. Hinderliter (Oil Field Specialties), 7 South Greenwood, Tulsa, *referring to* WORLD OIL *item* 196.

GM Diesel Powered



Pictured above is the AJAX, small as tugs go, yet capable of delivering better than 300 usable horsepower to a 52" diameter by 46" propeller at around 350 turns per minute. That's a lot of power for a fifty-five footer, but thanks to modern engine design and a twin 71 G.M. Diesel, furnished by GEORGE ENGINE COMPANY of New Orleans, it has been accomplished. Such a power plant easily delivers a speed of 11 miles per hour, running light, according to her owners, Guidry and Savoie of Cutoff, Louisiana. Captain Richoux believes that the AJAX has the power to tow three 6 or 7 thousand barrel barges in the Intercoastal Canal. The tug has quick acceleration and spins on a dime with very little heel.

With such a power plant as in the AJAX, repairs are cut to a minimum there's an economy of operation heretofore unachieved. When repairs do become necessary, a complete overhaul can be made in a minimum of time. Efficient maintenance, together with complete parts service, is supplied thru George Engine and its Dealers and Branches on a "Round the Clock" basis.

GM GENERAL MOTORS DIESEL POWER

George ENGINE CO., Inc.

1111 Jefferson Highway P. O. Box 10054 New Orleans 21, La.
630 Destrehan Ave. (on Harvey Canal)
Lake Charles Branch ..... 718 Front Street

BRANCHES OR DEALERS AT:
Houma Berwick Grande Isle

GROVE PB-300 *Pressure Buster* Regulator

*"PAID FOR ITSELF IN 30 DAYS"

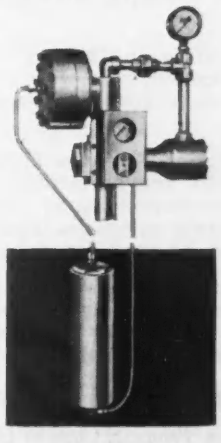
After 3 Days
Standard valve shows erosion from intense sand-cutting action
After 11 Months
PB-300 valve shows negligible wear, no erosion

Here's an installation that shows the rugged wear-resistant stamina of the Grove PB-300 *Pressure Buster* Regulator. Operating as a flow-line choke on a natural gas service at Houston, Texas, a standard regulator was previously used to reduce well-head pressure from 3000 p.s.i. down to 600 p.s.i. The terrific cutting action of sand in the distillate was so severe that in just 3 days of operation deep grooves were worn into the valve, necessitating installation of a new valve every three or four days.

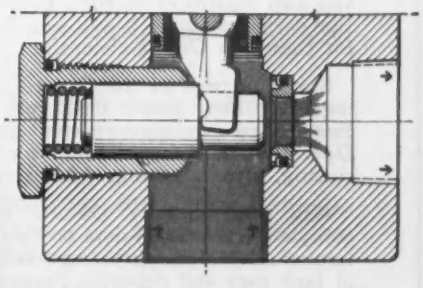
Grove engineers investigated the problem, inspected the worn parts and recommended the installation of a PB-300. It was calculated that if the new *Pressure Buster* stood up to this grueling service for only 30 days, it would have paid for itself. Yet this installation has worked unfailingly for more than 11 months; you can inspect the valve seating surfaces for yourself. A million cubic feet of gas a day is handled by this regulator, and cutting action has been reduced almost to nil.

** If you don't believe it—just drop us a note and we'll prove it — to your complete satisfaction.*

That's the kind of service you get from Grove Regulators. Readily adaptable for Back Pressure or Pressure Reducing service by switching connections, the PB-300 offers many other outstanding advantages that make it your logical choice for the severest services. So investigate the *Pressure Buster* today . . . Write or wire for full details.



GROVE
PB-300 REGULATOR



Note how the flow through the PB-300 valve is directed away from the regulator parts ensuring minimum wear and long trouble-free life.

GROVE

GROVE
SIMPLICITY
ACCURACY
SAFETY

"PUTS PRESSURE TO WORK"

MODEL PB-300
Pressure Buster
REGULATOR

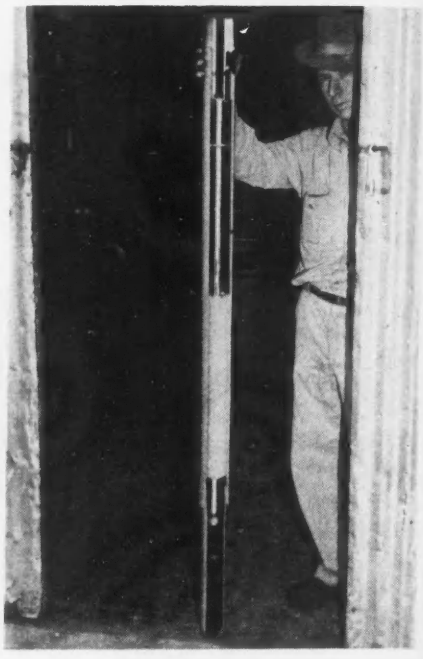
GROVE REGULATOR COMPANY • *65th & Hollis Street, Oakland 8, California*

3608 Navigation Blvd., Houston, Texas • *1930 W. Olympic Blvd., Los Angeles 6, California*

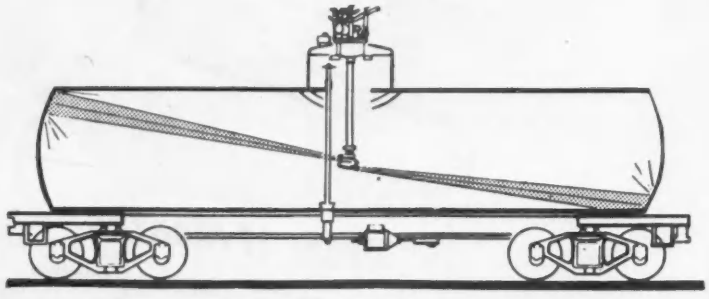
197—Filter Trap

Designed to remove sand and foreign matter from the oil before entering the pump barrel, a new-type filter incorporates many features that materially reduce production costs of pumping wells. The filter consists essentially of a short length of tubing, the same size as that in the well, inside of which is a chamber partially filled with some 6000 tempered agate balls. Screwed to the bottom of the pump shoe, this tool admits the well fluid through ports in the lower end, filters out sand particles, reduces emulsion and gas-lock conditions, and in other actions improves the operation of the pump.

Sand, shale and bits of rubber which often "sand up" balls and seats of the pump are filtered out by the agate pack, and with each stroke of the pump are ground up in ball mill fashion, the fine powder then being taken on up to be produced with the oil, or dropped into a mud anchor chamber on the bottom of the filter. Excessive pump wear and the likelihood of valves clogging is greatly reduced. Well surging which often is accomplished by excessive amounts of sand and gas, cannot clog the pump when the filter is attached, for the marble pack acts as a bean which controls the rate at which fluid can enter the pump barrel. Gas which breaks out in the filter passes on up to the top of the chamber where it escapes through ball check valves. So-called problem wells which could not be kept on production steadily because of sand, emulsion and gas-lock conditions, have been improved when equipped with the filter trap.



For additional information write to Filter Trap Company, P. O. Box 334, Santa Fe Springs, Calif., *referring to* WORLD OIL *item* 197.



• Cut Tank-Car Cleaning Time in HALF

• Eliminate "STEAMING-OUT" Time

The Fast, Money-Saving Oakite Way

THE scientifically designed Oakite Interior Tank-Car Cleaning Unit . . . a powerful, mechanized detergent-sprayer on lease to Oakite customers . . . cuts tank-car cleaning time in half by eliminating steaming-out time and by reducing laborious scrubbing and scraping to an absolute minimum.

For example, in cleaning lubricating and light-oil tank-car carriers you can figure on ½ to 1 hour cleaning-time with this amazing unit. For cars containing heavy oils, creosote, etc., count on 1 to 3 hours time for thorough Oakite clean-up.

Spray nozzles of the Oakite Interior Tank-Car Cleaning Unit move together. They rotate both vertically and horizontally with the result that soiled surfaces receive direct-impact spray every 15 minutes. Operation, after installation, is entirely automatic. Unit is also used for rinsing, after cleaning. And it may be used for stripping paint.

Ask your nearby Oakite Technical Service Representative, for complete operational data on this unit, including solution concentrations, temperatures, pressures, spraying and rinsing time for different types of tank cars and deposits. Free, without obligation. Do it today!

OAKITE PRODUCTS, INC., 37 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE 1909 1949 40th ANNIVERSARY YEAR

OAKITE

REG. U. S. PAT. OFF.

PETROLEUM SERVICE DIVISION

198—Welding Saddle

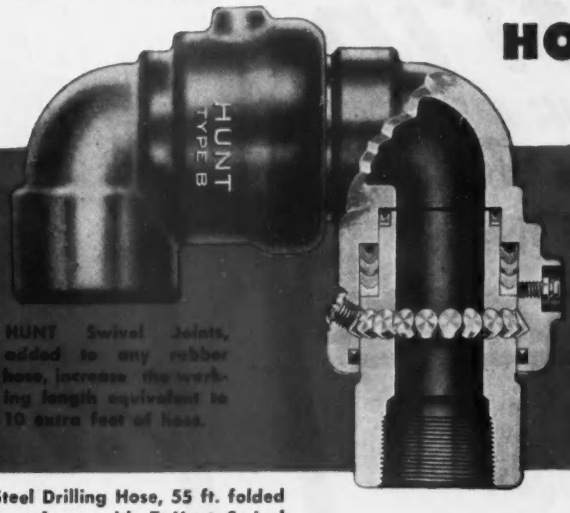
Flowing contour provides a wider reinforcing angle and allows ample space for the heaviest outlet-to-header welds underneath, in a new 45-degree outlet reinforcing welding saddle.

The saddle is available as a single-piece unit for new installations, as illustrated, and in split form (two halves) for installation where reinforcing is desired on lines already in use.

For additional information, write Pelican Well Tool & Supply Company, P. O. Drawer 1108, Shreveport 84, *referring to* WORLD OIL *item* 198.

IN MORE WAYS THAN ONE— YOU'LL TAKE THE *KINKS* OUT OF DRILLING...

with NEW HUNT Swivel Joints and HUNT All-Steel Drilling and Cementing HOSE



HUNT Swivel Joints, added to any rubber hose, increase the working length equivalent to 10 extra feet of hose.

The new HUNT Swivel Joint, easier to assemble and disassemble on rig floor, can be lubricated under full working pressure, easier to rotate under full working pressure.

HUNT All-Steel Drilling Hose, 55 ft. folded section shown here, with 7 Hunt Swivel Joints providing 17 swivel movements.

Available for 5,000 lb. (1″ through 4″ sizes) or 10,000 lb. (2″ only) working pressures . . . equipped with the *new* HUNT Swivel Joints (Roofe patents) . . . HUNT *All-Steel* Hose for drilling and cementing operations give you the SAFEST and EASIEST swiveling hose in the field.

HUNT *All-Steel* CEMENTING and DRILLING Hose provides as many swivel movements as desired—no more twists or kinks, nor lost time due to restricted hose movement in cementing or drilling.

The new HUNT Swivel Joints are designed so that cement, mud, caustic mud additives and other abrasives can not reach the joint's bearings. Neither internal or external pressures can dislodge this joint's packing during lubrication—*not even lubrication under full working pressure!*

And if you want greater operating freedom with any *rubber* hose—install HUNT Swivel Joints on both ends. Because your hose will then automatically extend itself to full length, the same length of hose will do the work of *an added 10 feet of hose!* Because your rubber hose will no longer twist, kink, or suffer other injurious distortions—you'll get faster drilling operations and longer hose life when you install HUNT Swivel Joints.

It will pay you to write *today* for our new catalog!

HUNT TOOL COMPANY

GENERAL OFFICES AND PLANT: HOUSTON, TEXAS
FIELD SHOPS: BAY CITY & CORPUS CHRISTI, TEXAS; JENNINGS & HARVEY, LA.
EXPORT SALES: HUNT EXPORT COMPANY, 19 RECTOR ST., NEW YORK; HOUSTON, TEXAS; BUENOS AIRES; PORT OF SPAIN; CARACAS

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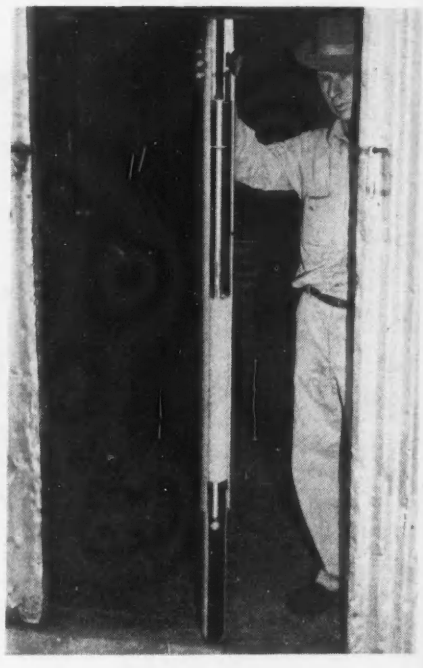

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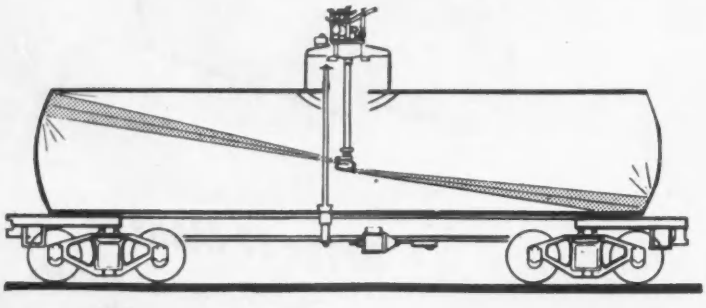

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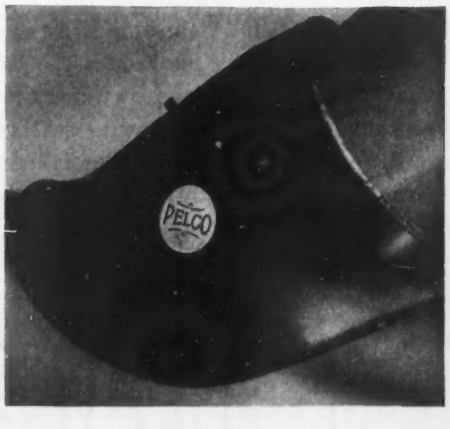

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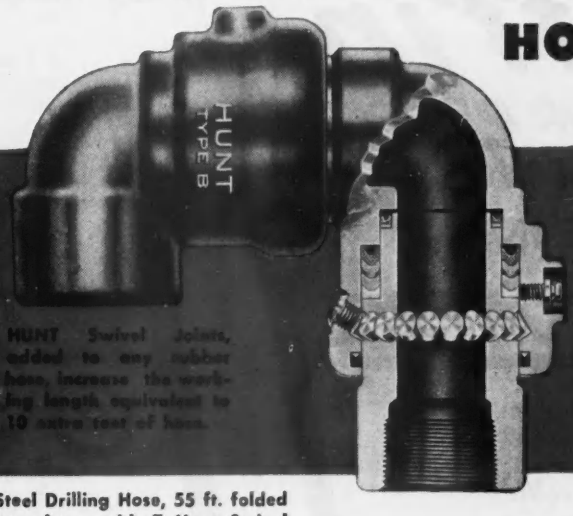

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A BUSINESS BUILT ON *Good* SERVICE

199—Heat Exchangers

The design and service of four types of heat exchangers using "Karbate" as protection against corrosive fluids and gases are featured in an illustrated brochure. Entitled "Karbate Heat Exchangers," the brochure shows other applications of "Karbate" such as an HCl absorber, an ejector for producing a high vacuum, and a standard heat exchanger for use in pilot plants and small volume processes. Physical properties of "Karbate" and a table giving its resistance to a large number of acids, salt solutions, alkalies, organic compounds, and gases and mixtures are also shown.

For a copy of this brochure, write Foster Wheeler Corporation, 165 Broadway, New York 6, *referring to* WORLD OIL *item* 199.

200—Carbureted Engines

Industrial engines and equipment for their operation on gasoline, kerosine, distillate or natural gas in a variety of applications, are described and shown in a new 12-page catalog covering four carburetor-type engines.

Design features of the engines are illustrated by sectional views. Charts reveal horsepower, torque and fuel consumption at various engine speeds for each model. Other illustrations show job-adapted units suitable for such work as pumping crude in the oil fields. Specifications and dimensions are given for each of the four engines.

For a copy of the booklet, A-164-MM, write International Harvester Company, 180 North Michigan Avenue, Chicago 1, *referring to* WORLD OIL *item* 200.

Paraffin
EATING UP YOUR PROFITS?
SUNSHINE IRON WORKS
SPECIALIZE IN
PARAFFIN CONTROL
Stop that paraffin before it stops your pumping; use field-engineered Sunshine Iron Works Automatic Paraffin Control Tools. For regular surface line cleanout depend on the S-I-W Ball Rabbit and Ball Dispenser. The Dispenser holds a 3 months' supply of Balls, and is installed in the line near the well. Your pumper merely works a couple of plungers once a week to release Ball Rabbits into the tubing. It's easy to collect the Balls from the trap, and re-load Dispenser. Wax and oil are saved by being regularly mixed and driven into the tanks. S-I-W's Ball Rabbit is made of 14 gauge sheet metal, with keen scraping edges that keep a full opening at all times. Sunshine Iron Works Paraffin Control Tools collect the paraffin that may keep you from collecting maximum allowable.
Sunshine Iron Works
601 W. MURPHY - PHONE 4374 - ODESSA, TEXAS

201—Tool Joints

A bulletin on Spang Double Seal Shrink Thread Drill Pipe and Tool Joints describes in detail the improvements recently made in the joint. The two distinct seals—external and internal—are clearly illustrated. A companion bulletin on Extreme Line Casing will be included upon request.

For copies of these two bulletins, write Spang-Chalfant Division, The National Supply Company, Grant Building, Pittsburgh, *referring to* WORLD OIL *tiem* 201.

202—Escape Mechanism

A new folder describes "Geronimo," the escape mechanism used by oil companies and drilling contractors for emergency landings from the derrick top. Originally weighing approximately 30 pounds, through the use of lighter and stronger materials the mechanism has been reduced in weight to approximately 16 pounds.

For a copy of this folder, write Charlie's Machine Works, Perry, Okla., *referring to* WORLD OIL *item* 202.

203—Hard Facing Wire

Wire for executing the Colmonoy Spraweld Process, a hard facing method combining welding and metallizing procedures, is described in a new seven-page booklet. The wire is designed for use in standard metallizing guns.

Complete application instructions for surface preparation, spraying and fusing, cooling and finishing are contained. Information is given on proper settings on standard wire metallizing guns.

For a copy of this booklet, write Wall Colmonoy Corporation, 19345 John R Street, Detroit 3, *referring to* WORLD OIL *item* 203.

204—V-Belts

A 100-page manual to assist engineers in designing both multiple and light duty V-belt drives contains a comprehensive set of drive tables for multiple belts; sheave data including construction, dimensions and weights; fractional horsepower drive layouts; comparison tables with information in quarter turn drives and hexagon double V-drives.

For a copy of this manual, write U. S. Rubber Company, Rockefeller Center, New York 20, *referring to* WORLD OIL *item* 204.

DEPENDABILITY THROUGH RESEARCH AND ENGINEERING

IN INDIAN TERRITORY: running a 5000-foot combination string of 7-inch S-80 SMITHway Casing, in Oklahoma.

ON THE MISSISSIPPI: SMITHway Casing can be shipped by barge as well as by rail. This barge load is going down river to Louisiana.

A.O. SMITH 75th ANNIVERSARY 1874 1949

SMITH*way* CASING · LINE PIPE

A. O. SMITH CORPORATION

New York 17 • Pittsburgh 19 • Atlanta 3 • Chicago 4 • Tulsa 3 • Dallas 1
Houston 2 • Seattle 1 • Los Angeles 14 • International Division: Milwaukee 1

Associations

Pacific Coast Officers Named By API Production Division

Registered attendance at the two-day session of the American Petroleum Institute, Division of Production, Pacific Coast district, numbered 1065. At the meeting, held at the Biltmore Hotel, Los Angeles, 13 technical papers were presented. Also given was a paper on the "Status of the Tidelands Issue" by Irving Smith, city attorney of Long Beach, Calif. Featured speaker at the Thursday banquet was Goodwin J. Knight, lieutenant governor of California, who spoke on "Politics is Your Business."

M. B. Standing, California Research Corporation, La Habra, was elected chairman of the group. District vice chairmen include E. Robert Burns, McDonald & Burns, Los Angeles Basin district; A. B. Dooley, Belridge Oil Company, San Joaquin Valley district; Benton Turner, Jr., Lloyd Corporation, Coastal district; and R. W. Walling, Division of Oil and Gas, Coalinga-Kettleman district. C. T. Reichert, The National Supply Company, was chosen treasurer, and Mrs. Elsie M. Edmiston was named secretary.

OIL SCOUT OFFICERS—New officers of the National Oil Scouts and Landmen's Association are, left to right, Frank Fagan, Atlantic Refining Company, Wichita, Kansas, third vice president; Fred Tyner, The Pure Oil Company, Roswell, N. M., first vice president; Chester H. Geiger, The Carter Oil Company, Mattoon, Ill., secretary-treasurer; S. N. Jackson, Sun Oil Company, Dallas, president; and Fred S. Alexander, Standard Oil Company of Texas, Amarillo, Texas, editor in chief of the Association's yearbook. Not pictured is George Saverline, Sun Oil Company, Shawnee, Okla., second vice president.

"Storm Standby Pump"
Is Powered By A
WISCONSIN
HEAVY-DUTY
Air-Cooled
ENGINE!

When storms or bad weather strike and halt electric power . . . then this Wisconsin Heavy-Duty Air-Cooled Engine goes to work . . . powering a rotary standby pump, handling one barrel of crude oil every minute at an Oklahoma Oil Field.

Whether "standing by" as this engine does, ready for instant action . . . or delivering husky dependability day in and day out, Wisconsin Engines are the power choice among the men who build dependable oil field equipment and the men who keep 'em working. All agree that Wisconsin Engine power is unsurpassed in the 2 to 30 hp. air-cooled range because of such features as tapered roller bearings at both ends of the crankshaft, assuring correct and constant alignment whether the work is light or heavy . . . positive air-cooling in temp. to 140°F., . . . and quick starting and steady running in sub-zero weather due to an easily serviced OUTSIDE magneto with impulse coupling.

4-cycle single, two-, and four-cylinder types, 2 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

Oklahoma Landmen Organize; Elect Sutherland President

Landmen representing 22 oil and gas companies in the Tulsa and Bartlesville, Okla., area, have formed the Tulsa Land Men's Association with 35 charter members. Main purpose is to provide a medium through which landmen may become better acquainted.

Buford F. Sutherland, division land supervisor, The Atlantic Refining Company, was elected president of the association. Other officers are J. H. Marsh, The Carter Oil Company, vice president; Ish Pilkington, Barnsdall Oil Company, secretary; A. L. Chapman, Wilcox Oil Company, treasurer.

Members of the executive committee are Louis Roark, Sunray Oil Corporation; Fridolf Swenson, Deep Rock Oil Corporation; A. D. Benedict, Tide Water Associated Oil Company; John K. Barrows, Oklahoma Natural Gas Company and Al Cashman, Skelly Oil Company.

Western Oil and Gas Group Appoints Technical Secretary

Paul G. Brown has joined the staff of the Western Oil and Gas Association as technical secretary. He succeeds George F. Prussing, resigned.

Brown, a chemical engineer, has had experience in activities relating to engineering problems arising out of relationships between government and private industry.

Before joining the association's staff, he was an industrial hygiene engineer with the County of Los Angeles.

great names

POWELL VALVES

Iron Body, Bronze Mounted "Master Pilot" Gate Valve with: Non-heating hand wheel secured by a lock-nut. Bronze hex packing nut and bronze gland. Large stuffing box. Body-bonnet bolts in slotted lugs for easy removal in case of thread damage. Extra-long thread on stem. Machined seat and collar so that valve may be repacked under pressure. Gasket in machined gasket seat. Taper wedge solid disc. Seat faces faced for proper disc alignment. Ample space between pipe-end and seat. Heavy wall thickness of body and bonnet. Another fine product, available at UNITED stores.

Uncle Sandy

THE UNITED SUPPLY MAN

● "THEY SPEAK FOR THEMSELVES."

Courtesy
Service
Dependability

UNITED SUPPLY
AND *Manufacturing* COMPANY
TULSA, OKLAHOMA
Stores in Kansas, Oklahoma, Texas,
Louisiana, and New Mexico

Oil Contributions Finance Tulsa University Building

Ten oil companies and three independent oil operators have contributed $850,000 for the construction of a Petroleum Science hall on the University of Tulsa campus. The building will contain 15 laboratories, 10 classrooms, 11 offices, geological sample rooms, a reading room, 250 capacity auditorium, balance room, dark room, seminar rooms, small research rooms, sample workrooms and preparation rooms. The new hall will house the Geology, Chemistry, Physics, Geophysics and Geography departments.

A bronze plaque to be hung in the lobby of the new building will read, "Petroleum Science hall . . . a gift of the oil industry to the University of Tulsa for the education and training of youth to better serve humanity through the medium of oil and its by-products."

Grants for the building were made by Tulsa Rig and Reel Company and the Flint Steel Company, presented by C. W. Flint, president; National Tank Company by Jay P. Walker, president; Williams Brothers Corporation by Cecil Stanfield, vice president; Parker Drilling Company, by Gifford C. Parker, president; Arthur A. Olson, president, Olson Drilling Company; A. G. Oliphant, oil operator; The Carter Oil Company by O. C. Schorp, president; Waite Phillips, investments; Skelly Oil Company, by W. G. Skelly, president; Sunray Oil Corporation, by C. H. Wright, president; Stanolind Oil and Gas Company by E. F. Bullard, president; and The Ohio Oil Company, by Glenn Bish, division manager.

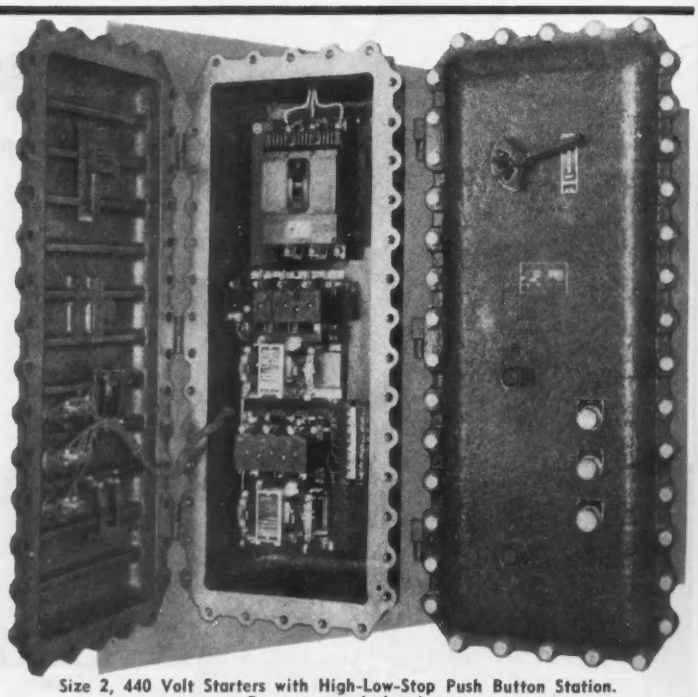
DALLAS NOMADS OFFICERS—Officers and committeemen of the Dallas Chapter of Nomads for 1949 are, left to right, front row, C. A. McClelland, charter member; J. C. Baseheart, president; Brad Mills, regent; C. J. Berlin, secretary; J. A. Mussler, membership. Back row, E. J. Whetzle, treasurer; Vic LeMay, entertainment; A. J. Olson, sergeant-at-arms; E. J. Shiels, assistant secretary; J. E. Everroad, membership. Officers not shown are R. J. Bauer, vice president; Earl Smith, assistant sergeant-at-arms; and F. I. Brinegar, regent.

Lukert Is Chosen President Of Tulsa Geological Society

Louis H. Lukert, division geologist, Oklahoma division, The Texas Company, has been elected president of the Tulsa Geological Society.

Other new officers include Dan A. Busch, research geologist, The Carter Oil Company, first vice president; John Nash, Shell Oil Company, second vice president; Miss Mary Whitehead, Stanolind Oil and Gas Company, secretary-treasurer; Oscar E. Wagner, Jr., Mid-Continent Petroleum Corporation, editor; V. L. Frost, The Ohio Oil Company, business manager; Dr. Joseph A. Sharpe, Frost Geophysical Company, Jack Copass, independent, and L. Murray Neumann, members of the society council.

"THE PERFECT COMBINATION"



Size 2, 440 Volt Starters with High-Low-Stop Push Button Station. Door open and closed.

NEMCO TWO-SPEED COMBINATION MOTOR STARTER MOUNTED IN NEMCO EXPLOSION-PROOF ENCLOSURE

■ The NEMCO Class 423 Two-Speed Combination Motor Starter is a product that approaches perfection in its down-to-earth design . . . in the fine skill which is reflected in the mounting and in the wiring of its component parts . . . and in the high quality of the NEMCO Castings which are used for its explosion-proof enclosure.

This starter is used for the control of two-speed motors in Class 1, Group D, Hazardous Locations. Outstanding features include: (1) Wide angle opening of swing door gives complete accessibility; (2) Extra wide flame paths on ground surfaces between cover and box insure safety; (3) Pan-mounted equipment can quickly be removed, providing maximum ease and space for pulling in wires; (4) Start-stop station and resets are mounted directly in cover; (5) Offered in sizes up to and including Size 3, 440 Volt, 50 H.P. You are invited to write for complete information.

NELSON Electric MANUFACTURING CO.

217 North Detroit TULSA, OKLAHOMA Telephone 2-5131

Manufacturers of: Explosion Proof Motor Controls, Junction Boxes and Enclosures, Circuit Breakers and Lighting Panels, Oil Field Motor Controls, Automatic Pipe Line Sampling Devices, Cathodic Protection Equipment, Switchboards, Instrument and Control Panels, Unit Substations.

PROOF - *not Guesswork*

Makes FWD America's Foremost Heavy-Duty Truck

Here's actual operating proof in oil field service. This FWD six wheeler — doing an everyday job — is going cross-country through mud and clay to deliver equipment. Yes — power and dependability needed for tough jobs like this are built into every FWD Four or Six Wheel Drive Truck. You can be sure of this even before you buy, because FWDs are scientifically tested on FWD's proving ground to plow through mud and clay that reach over the bumper. *No wonder many of the world's leading oil field operators standardize on FWDs—with individual fleets of over 600 units.*

WHAT FWDs DO ON THE PROVING GROUND
1 Highball over hilly curved roads!
2 Slog thru mud — up to the bumper!
3 Speed over 100-ft. unbanked circle!
4 Twist over ditches —18 inches deep!
5 Drive up 6% grade thru 3-ft. of sand!
6 Climb 70% grade from dead stop!
7 Climb 8-in. beam from standstill!
8 Drill pole holes to prove equipment!
9 Speed safely over level highways!
1
2
3
4
5
6
7
8
9

This is FWD's proving ground. This is your assurance that the FWD you select has the stamina to insure long life without expensive mechanical breakdowns.

An FWD slogs through the "mud hole" at the proving ground. For all the facts, see your FWD distributor — or write FWD direct.

An Invitation To Truck Buyers

We invite you to watch FWDs pass a series of rigid performance tests. Ask your FWD distributor to arrange your visit to our plant. Or — if you can't get away, ask him to show you the movie, *The FWD Story*. In either case, you will see for yourself how FWD trucks can help solve your heavy-duty trucking problems.

Walter G. Olson
President
The Four Wheel Drive Auto Company

THE FOUR WHEEL DRIVE AUTO COMPANY
Clintonville, Wis. • *Canadian Factory:* Kitchener, Ontario
FOUR AND SIX WHEEL DRIVE TRUCKS

America's Foremost Heavy-Duty Truck

Houston Section SEG Elects Officers, Honors McCollum

The first honorary lifetime membership to the Houston Section of the Society of Exploration Geophysicists was bestowed upon Burton McCollum, head of McCollum Exploration Company, Houston, for his pioneering, his outstanding contributions and his leadership in the field of geophysics. Roy L. Lay, The Texas Company, past president of the Houston Section, made the presentation on behalf of the Section at its annual banquet held in Houston.

Present for the award was Dr. E. A. Eckhardt, vice president of the Gulf Research & Development Company, Pittsburgh, and Dr. J. C. Karcher, consulting geophysicist, Dallas, both early associates of McCollum.

Jack Pollard, Robert H. Ray Company, was elected president of the Houston Section succeeding Lay. Other officers elected were first vice president, Derry Gardner, Humble Oil & Refining Company; second vice president, Roy Bennett, Sohio Petroleum Company; secretary, W. H. Gibson, The Texas Company; and treasurer, C. H. Broussard, Independent Exploration Company.

GEOPHYSICIST IS HONORED—Roy L. Lay, The Texas Company, past president of the Houston Section, Society of Exploration Geophysicists, left, congratulates Burton McCollum, president of McCollum Exploration Company, Houston, upon being awarded the section's first honorary lifetime membership. McCollum is one of the founders of American geophysics.

Louisiana-Arkansas Group Will Meet September 22-23

September 22 and 23 are the dates of the 27th annual convention of the Louisiana-Arkansas division, Mid-Continent Oil and Gas Association, President A. R. Carmody announced. The convention will be held in New Orleans, with headquarters at the Roosevelt Hotel.

Several outstanding speakers will head the convention program, which also includes the annual election of officers.

Westsmith Will Head AAODC Public Relations, Membership

Jack N. Westsmith has been employed by American Association of Oilwell Drilling Contractors to direct public relations and membership work. He succeeds Jeff Young, who resigned two months ago.

Jack N. Westsmith

Westsmith resigned as editor and general manager of *Petroleum World*, Los Angeles, to accept the position in Dallas. He was graduated from Stanford University in 1928 with a degree in mechanical engineering.

Fort Worth Engineers Elect

R. J. Holley, Gulf Oil Corporation, was elected president of the Petroleum Engineers Club of Fort Worth. Other officers are J. A. Slicker, Stanolind Oil & Gas Company, executive vice president; R. H. Rantala, The Pure Oil Company, first vice president; J. W. Sallee, second vice president; and Jack O'Brien, Oil Well Supply Company, secretary-treasurer.

Star's "Rubber-Mount" design places 30 rubber mountings under the crown sheave (illustration below) and in the spudder. The spudder floats completely on rubber at all bearing points and sheaves.

The NEW No. 72 "Rubber-Mount" SPEED STAR . .

✔ NEW, PROVEN DESIGN
✔ NEW DRILLING ACTION
✔ NEW EARNING TOPS

. . . ONE OF A SERIES OF MODERN, • PROFIT-MAKING • DRILL RIGS BUILT BY A COMPANY 60 YEARS IN BUSINESS

ANOTHER "FIRST"—

Star's patented "Rubber-Mount" design, which gives full protection to the machine and develops a powerful drilling motion with terrific penetrating ability. The No. 72 Speed Star easily swings tools averaging 2500 lbs. on wells 6" to 16" diameter. It is ideal for the drilling and cleaning out of shallow wells.

Ask for Bulletin No. 72-B.

OTHER No. 72 FEATURES:

1. Star's famous balanced construction distributes load, eliminates side strain and prolongs life.
2. Double catheads are regular equipment, with friction clutch control for safety.
3. Extra large capacity masts with power hoists.
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Mountings: truck, full trailer, semi-trailer.

"If It's a Speed Star, It's a Fast, Proven Money-Maker"

THE STAR DRILLING MACHINE COMPANY

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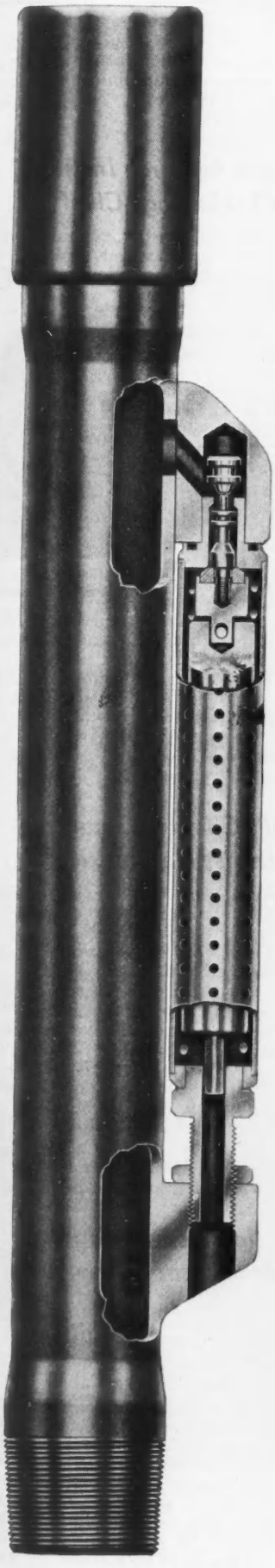
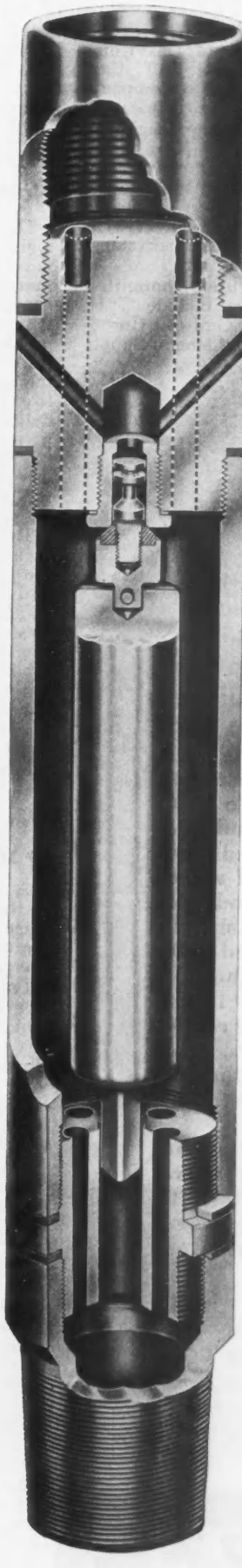
Drilling Machines and Tools Since 1889



Pat. Pending



Pat. Pending

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"Weight Loaded"

GAS LIFT FLOW VALVES

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—Save Input Gas
—Increase Production

Operators who have wells now producing thru Jet Collars with a high gas-oil ratio, will welcome the new Nixon "Weight Loaded" Gas Lift Flow Valves—for every well in which they have been run—input gas volume has been reduced to a great extent.

In many instances a major increase in production has occurred.

The new Nixon "Weight Loaded" Gas Lift Flow Valves are made for both Constant Flow and Intermittent Flow. The Intermittent Flow Valves are recommended for wells producing a small volume of fluid.

These new valves are simple in design and have no parts which fail thru fatigue. They remain in calibration throughout their long life. Can be completely serviced in the field.

★

—for Tubing Flow

For medium and high Producing Fluid Level Wells, where the amount of fluid to be produced does not exceed the capacity of the tubing—Nixon "Weight Loaded" Gas Lift Tubing Flow Valves are recommended. (Shown at far left.)

—for Casing Flow

When wells are located in heavy water drive fields, where it is necessary to produce more fluid than can be handled thru the tubing, Nixon "Weight Loaded" Gas Lift Casing Flow Valves really do the job. (Shown at left.)

★

If you are interested in these NEW "Weight Loaded" Differential Gas Lift Flow Valves—write for complete information contained in a 24-page illustrated booklet giving installation and operating data. Address:

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P. O. Drawer 19, Houston, Texas, or contact your nearest Wilson Supply Store.

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BRANCH STORES: TEXAS—Kilgore, Beaumont, Barbers Hill, Bay City, Monahans, Alice, Victoria, Corpus Christi, Columbus. LOUISIANA—Lake Charles, New Iberia, Harvey, Shreveport, Houma. ARKANSAS—Magnolia.

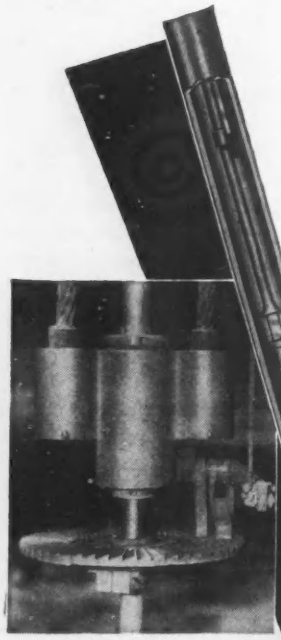
ASME Mid-Continent Section Elects A. A. Hardy Chairman

A. A. Hardy, W. C. Norris, Manufacturer, Inc., Tulsa, has been elected chairman of the Mid-Continent Section, American Society of Mechanical Engineers. Other new officers are W. C. Moody, The National Supply Company, first vice chairman; E. E. Klockman, Phillips Petroleum Company, Bartlesville, Okla., second vice chairman; R. G. Paddock, University of Arkansas, Fayetteville; R. E. Venn, Oklahoma A. and M. College, Stillwater, Okla.; W. S. Sherman, Jr., Sherman Machine and Iron Works, Oklahoma City; E. T. Rogers, Shamrock Oil and Gas Company, Amarillo, Texas, and J. T. Carmichael, The Brewster Company, Shreveport, district vice chairmen.

Dean A. Foster is vice chairman student branches; J. H. Keyes, Jr., Stanolind Pipe Line Company, vice chairman membership; R. H. Brooks, Jr., Enardo Manufacturing Company, vice chairman programs; Guy F. Williams, Dowell Incorporated, secretary; C. A. Stevens, treasurer.

Members of the executive committee, in addition to the above, include C. H. Blue and F. J. Daasch, Gulf Oil Corporation; R. G. Critz, Bethlehem Supply Company; C. O. Glasgow, National Tank Company; D. R. Turner and O. L. Lewis, Jones and Laughlin Supply Company, and J. H. Keyes, Sr., Dempsey Pump Company.

WHAT ARE YOU PAYING FOR PARAFFIN REMOVAL?



TOO MUCH — If your pumping wells are not equipped with HUBER SCRAPERS

Many major companies report Huber Scrapers have completely eliminated paraffin removal costs or reduced them to only a fraction of a cent per barrel of oil produced. Huber Scrapers, shrink-fitted to new or used sucker rods, scrape the paraffin from the tubing wall as the string rotates and reciprocates. Rods are rotated by the special Huber Rotating Rod Hanger.

Reduce or eliminate your paraffin removal costs with Huber Scrapers. Write for latest bulletin.

HUBER ROTATING ROD HANGER

This rod hanger rotates the rod string a fraction of a turn on each reciprocation. Two ratchet levers, operated by a flexible cable extending from the walking beam, engage the teeth in the turntable to turn the rod string.

Sold through supply stores.

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BORGER, TEXAS

HUBER
PARAFFIN SCRAPERS
SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

Southwest Research Institute Names Technology Chief

Dr. William B. Mather, economic geologist, has been appointed chairman of mineral technology of Southwest Research Institute, with headquarters in San Antonio. He will be in charge of ceramics, metallurgy, mineralogy and geology. His special fields also include petrology, chemical microscopy, mineralography, petrography and geochemistry.

Dr. William B. Mather

Receiving his education at McMaster University in Ontario and the University of Chicago, Dr. Mather resigned from Midwest Research Institute's staff at Kansas City to join the Southwest institute.

The Institute also announced the election of H. R. Cullen, president of Quintana Petroleum Corporation, Houston, and George A. Hill, Jr., president of Houston Oil Company of Texas, to the board of trustees.

New API Chapter Organized In Southeast New Mexico

A Southeastern New Mexico Chapter of the API Division of Production has been organized at Hobbs, N.M. Paul C. Evans, Gulf Oil Corporation, Hobbs, was elected chairman.

Other officers of the chapter are, first vice chairman, Charles D. Sands, The Ohio Oil Company, Hobbs; second vice chairman, Ralph L. Gray, Buffalo Oil Company, Artesia; and third vice chairman, W. M. Halloway, The National Supply Company, Hobbs. M. B. Moseley, Gulf Oil Corporation, was appointed secretary-treasurer.

Seventy-five oil men attended the organization meeting and enrolled.

Production Pioneers Hold Fifth Anniversary Barbecue

Marking the fifth anniversary of the organization, Petroleum Production Pioneers held a barbecue at Shell Oil Company's barbecue grounds in Wire Rope Canyon near Brea, Calif.

Unique in its organizational setup, the Pioneers group consists of two classes of memberships. Junior members must have been in the oil business at least ten years, and senior membership is restricted to those with 30 years in the business. A ratio of one junior to four senior members is maintained, and juniors are required to perform all work which has for its effect honoring the older members of the industry. There are now more than 1100 members.

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In every way, economy, dependability, smoothness of operation and prompt, efficient service—International Power Units give excellent performance. Visit your International Industrial Power Distributor, Power Unit Dealer or Supply House and "buy International" now for money-saving power.

INTERNATIONAL HARVESTER COMPANY
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An International UD-24 Diesel Power Unit, rated at 180 horsepower, driving a mud pump on a Russell & Russell drill rig.

W. F. RUSSELL — W. O. RUSSELL

RUSSELL & RUSSELL
OIL OPERATORS, PRODUCERS AND CONTRACTORS
GAINESVILLE, TEXAS.

January 31st, 1949

Mr. H. R. Carlson, Ass't Dist. Mgr. Industrial
International Harvester Company
1809 South Lamar Street
Dallas, Texas

Dear Mr. Carlson:

On April 28th, 1948, we purchased our first UD-24 - 180 Horsepower International Diesel Power Unit, which was used to power a 6 x 12 Oil Well mud pump. To date we have drilled 15 wells with a total footage of 30,000 feet. No engine maintenance expense to date.

This UD-24 replaced an engine operating on butane. We find it cost us 33% less to operate your Diesel engine over our previous butane equipment. We also find you have a vibrationless engine and the easiest to start of any make engine we have ever used.

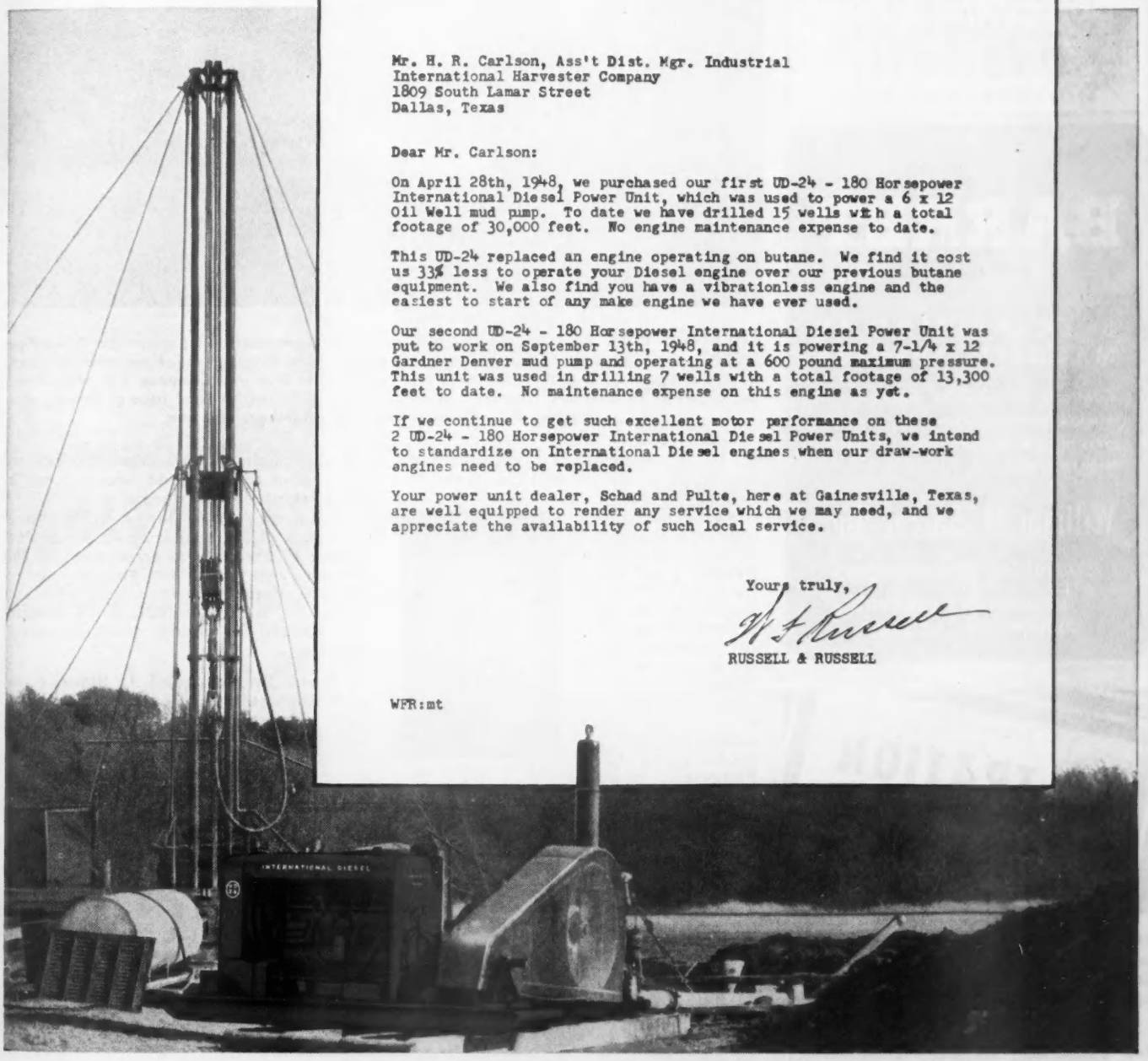
Our second UD-24 - 180 Horsepower International Diesel Power Unit was put to work on September 13th, 1948, and it is powering a 7-1/4 x 12 Gardner Denver mud pump and operating at a 600 pound maximum pressure. This unit was used in drilling 7 wells with a total footage of 13,300 feet to date. No maintenance expense on this engine as yet.

If we continue to get such excellent motor performance on these 2 UD-24 - 180 Horsepower International Diesel Power Units, we intend to standardize on International Diesel engines when our draw-work engines need to be replaced.

Your power unit dealer, Schad and Pulte, here at Gainesville, Texas, are well equipped to render any service which we may need, and we appreciate the availability of such local service.

Yours truly,
W. F. Russell
RUSSELL & RUSSELL

WFR:mt



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A QUICK, POSITIVE LOAD, REGARDLESS OF FLUID LEVEL.

Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.

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Men in the Industry NEWS

FINANCE PIPE LINE—Claude A. Williams, center, president of Transcontinental Gas Pipe Line Corporation, and John F. Burton, right, vice president and treasurer, are shown receiving check for $70 million from Greene F. Johnson of Metropolitan Life Insurance Company. This represented the largest of 18 insurance company participations in a $143 million bond issue to finance construction of the Texas to New York natural gas pipe line.

R. W. McDowell, Tulsa, has been elected president of Mid-Continent Petroleum Corporation, stepping up from executive vice president and succeeding **Jacob France,** chairman of the board who assumed the company presidency last August following the resignation of **F. B. Koontz** because of illness. At the same time the directors announced the promotions of **T. W. Fitzgerald,** general sales manager, to vice president in charge of marketing; **G. E. Wynn** to vice president in charge of manufacturing; **D. Glen Morgan** to director of research and development, a newly-created department.

R. W. McDowell

The directors also elected **Koontz,** vice chairman of the board; **R. H. Wills** and **Albert E. Pierce,** vice presidents; **E. M. Rouzer,** vice president and secretary; **Charles Klein,** treasurer and assistant secretary; **B. P. Lambert, A. D. Kneale** and **Roland H. Brady,** assistant secretaries.

B. Frank Bridges and **J. L. Stauss** have been appointed president and vice president, respectively, of the newly organized drilling company, Falcon Seaboard of Canada, Ltd., which has been formed to operate in Canada and more particularly in the Alberta region. Bridges, formerly with Gulf Refining Company will maintain headquarters at Calgary.

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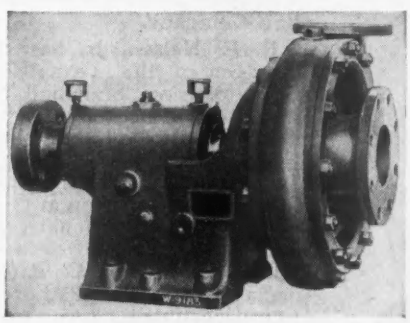

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From WAR to OIL... Conversions of all types and sizes of craft.

Personnel and service launches built of STEEL! Speedy, efficient, rugged.

Towboats built and repaired. Marine work is our specialty.

AVONDALE
MARINE WAYS, Inc.

Main Plant: Avondale, La. *Quick Repair Plant: Harvey, La.*
MAIL: WESTWEGO, LA.

John K. Goldrick, pioneer oil man and former president of The Texas Pipe Line Company of Oklahoma, has retired after 42 years of continuous service with The Texas Company and its pipe line company affiliates. He worked in the coal mines until he was 19 and then went to Ohio, where he took a job with Manhattan Oil Company. After working at various oil field jobs in Indiana and Kansas he joined the Texas Pipe Line Company in 1907 as a gauger and was advanced steadily. His positions included chairman of the board, vice president and general manager of the Kaw Pipe Line Company; vice president and a director of The Texas-Empire Pipe Line Company. As representative of The Texas Company he purchased all the crude oil bought by that company in Oklahoma, Kansas, Illinois and Kentucky for the past 30 years.

»

Lieut. Gen. W. S. Key, Oklahoma City banker and oil operator, and **J. A. LaFortune,** executive vice president, Warren Petroleum Corporation, Tulsa, have been elected directors of the Oklahoma Natural Gas Company, succeeding **D. D. Morgan,** deceased, and **Judge R. C. Allen,** resigned.

Designed especially for "tough going," AMERICANS have what it takes to render smooth, dependable service in heavy industrial applications. Strong, precision built, longer lasting, they will minimize your anti-friction bearing problems. Our technical staff will assist you in selecting the right bearings for your needs. Write.

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AMERICAN ROLLER BEARING CO.
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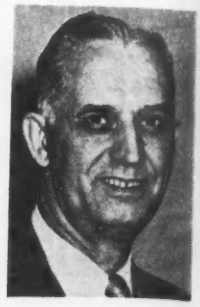
W. F. Dau has been elected treasurer of Sinclair Oil Corporation. Dau joined Sinclair Refining Company in 1917 as an employe of the accounting department at Chicago. In 1921 he was transferred to the Treasury department of Sinclair Oil Corporation in New York, where he remained until 1924 when he returned to Chicago and assumed charge of the company's financial operations in that area.



W. F. Dau

In 1929 he was again transferred to the New York office and in 1943 was elected vice president and assistant treasurer of Sinclair Oil Corporation. As treasurer, he succeeds **Marvin L. Gosney,** who was elected executive vice president.

»

J. W. Roach has been named division gas superintendent for Stanolind Oil and Gas Company at Fort Worth.

Roach will be responsible for the technical phase of the operation of Stanolind's natural gasoline, cycling and pressure maintenance plants in the division. These plants include the Slaughter gasoline plant near Sundown, Texas, and North Cowden and South Fullerton plants now being built. Roach also will be responsible for the sale of products from these plants.

G. F. Moore has been named division gas superintendent for Stanolind at Casper, Wyo. In the newly created post Moore will be responsible for the technical phase of the operation of Stanolind's natural gasoline, cycling and pressure maintenance plants in the Rocky Mountains division.

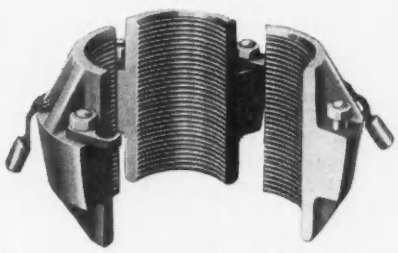
J. W. Bartram has resigned from the Public Relations department of Stanolind Oil and Gas Company, Tulsa, to accept the post of assistant to the president of the University of Colorado, Boulder, Colo., and has been succeeded by **William J. Nash** who is vice president of the International Council of Industrial Editors and has had extensive experience in public relations work with Monsanto Chemical Company and Bemis Bag Company.

R. E. Nelson, Jr. has resigned as manager of the Texas-Louisana Gulf Coast division, Stanolind Oil and Gas Company, to become assistant to President J. L. Burke of Stanolind Pipe Line Company at Tulsa. His successor is **F. J. Schempf,** former manager of Stanolind's Central division at Oklahoma who will now make headquarters in Houston and who in turn has been succeeded at Oklahoma City by **C. T. Jones,** former manager of Stanolind's Foreign Exploration department.

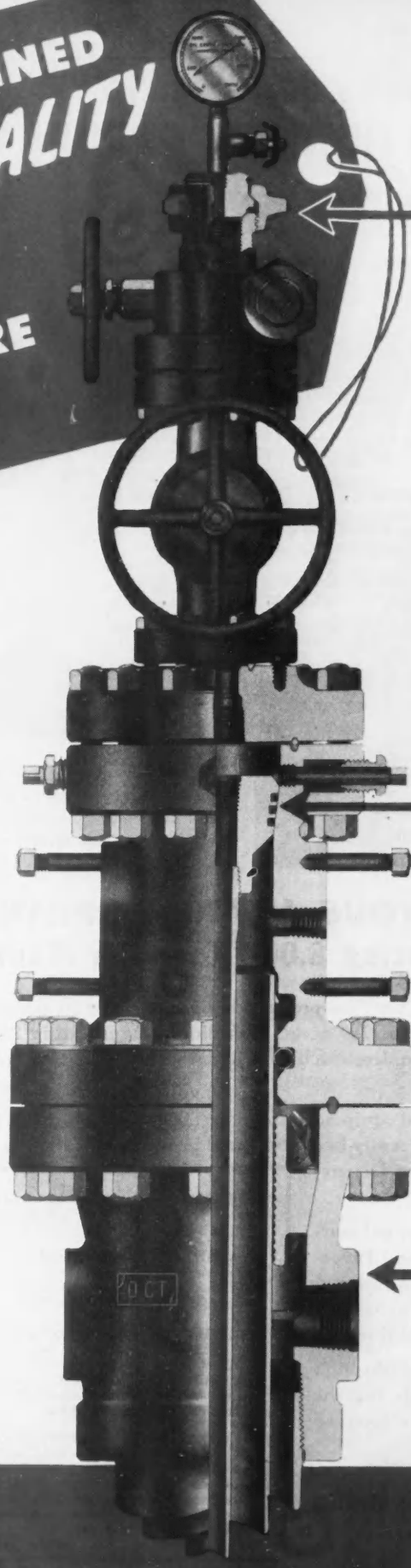
»

M. C. Hoffman has resigned as general superintendent of production for Stanolind Oil and Gas Company to become general manager of production and exploration for Root Petroleum Company at Shreveport.

O-C-T HAS COMBINED ECONOMY AND QUALITY IN THIS LOW PRESSURE ASSEMBLY



C-18-E SLIPS—Hinged for fast installation. May be dopped through preventers before cementing.



JE-1 FLOW CONTROL . . . four pieces in one—quick change wing valve.

T-16 THREADED HANGER (other interchangeable models available).

T-16 OU TUBING HEAD. Positive dual casing seal, no installation labor, reduced pressure area, low flange stress.

C-18 CASING HEAD BODY.

For areas where pressure around the casing at time of setting is not a problem and oil strings are less than 8000 feet, this quality O-C-T Wellhead Assembly offers a low cost, efficient unit, quickly installed without numerous loose parts.

The C-18-E Slips are conveniently hinged for handling and have maximum load capacity consistent with their length. They can be dropped through preventers to provide casing support before removing preventers, if desired.

The O-C-T OU Seal is positive and automatic. Simply cut casing off at right length, bevel edge and install tubing head.

Write today for complete engineering details on this high quality low pressure wellhead assembly.

NOTE: FOR DEEP WELLS WITH HEAVY STRINGS AND HIGH PRESSURES AND WHERE A SEAL IS NEEDED BETWEEN STRINGS PRIOR TO REMOVING BLOWOUT PREVENTERS, OUR C-19 CASING HEAD IS RECOMMENDED.

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

Export Representatives: Venezuela, Colombia, Peru and Ecuador—Berry & Hall, Apartado No. 304, Maracaibo, Venezuela—Sterling Areas—Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.

DEPARTMENT OF THE ARMY

OHIO RIVER ORDNANCE WORKS

HENDERSON · KENTUCKY

This plant constitutes a part of the National Industrial Reserve and has been designated for disposal subject to the National Security Clause.

THIS *ANHYDROUS AMMONIA* PLANT
Presently Producing 6,000 Tons Per Month

Built by the Government for wartime production of anhydrous ammonia, this $15,000,000 plant, consisting of 287 acres, 35 buildings aggregating 284,000 square feet of floor area, complete machinery and equipment, is now offered for sale.

All facilities, machinery and equipment are in excellent condition. The plant, adaptable to expansion, is currently being operated by the Solvay Process Company under contract with the Department of the Army.

Location contiguous to principal markets. Adequate transportation. Favorable for development of river-rail and terminal facilities. Low cost water supply. Ample waste disposal facilities.

Sale will be consummated through competitive bids. Sealed bids for the purchase of this facility will be received at the office of:

District Engineer
LOUISVILLE DISTRICT, OHIO RIVER DIVISION
630 Broadway
Louisville, Kentucky

LOCATION: 13 miles southwest of Evansville, Indiana, on U.S. Highway 60 and Ohio River.

TRANSPORTATION: Illinois Central RR serves plant. 4½ mi. spur track. Hard surfaced plant roads. Year around river navigation. Airport at Evansville, Ind.

UTILITIES: Power and light generated on site by 3 turbo-generators, capacity of 13,125 KVA. Stand-by power from Kentucky Utilities Co. Steam capacity 360,000 pounds per hour. Compressed air 1,030 c.f.m. Adequate fire protection.

MAJOR UNITS: Power plant; gas production plant; compression bldg.; synthesis bldg.; purification bldg.; maintenance, carpenter and machine shops; office bldg.; laboratory; barracks; cafeteria; service bldg.; stores; pump houses; warehouses. All fully equipped for use.

Detailed information, arrangements for inspection and bid forms may be obtained from the Real Estate Division at the above office.

CORPS OF ENGINEERS U. S. ARMY WASHINGTON, D. C.

MEN IN THE INDUSTRY NEWS

H. O. Harder, general superintendent of Sunray Oil Corporation's Production department in Tulsa, has been elected vice president in charge of production. He succeeds James K. Ellis, resigned, who has become associated with the Slick-Urschel Oil Company.

H. O. Harder

Harder has been with Sunray since 1945. He was named general superintendent of Sunray's producing operations in 1947.

Charles Dunlap, former Stanolind Pipe Line Company station engineer at Hufsmith, Texas, has been appointed area industrial relations supervisor for the company's West Texas division. He will have headquarters in the company's divisional office at Lubbock.

Dunlap joined Stanolind Pipe Line Company in 1931. Earlier he was employed by the Santa Fe Railway and by commercial firms in Tyler, Texas. From his Texas post, Dunlap was transferred in 1937 to Odessa, Mo., as a station gauger. He later became an oiler and in 1942 was made station engineer at Hufsmith.

Walter G. Beach, supervisor of publications, Humble Oil & Refining Company, Houston, was elected vice president of the southwestern area of International Council of Industrial Editors at the organization's annual convention in Toronto.

Walter G. Beach

Beach, who has been with Humble 12 years, is currently serving as president of the Society of Associated Industrial Editors, an organization of editors of company publications in Southern and Midwestern states.

Frank M. Hamner, formerly a geologist with Stanolind Oil and Gas Company at Lake Charles, La., is now with the Schermerhorn Oil Corporation at Tulsa as engineer geologist.

W. A. Bohan, Tulsa, has retired as assistant division manager of the Texas Pipe Line Company's oil traffic division, after 40 years of continuous service.

Stanley Learned, Phillips Petroleum Company, has been elected a director of the company and a member of the Executive Committee. Learned is chairman of the operating committee and during his 25 years with the company has served as chief engineer and superintendent of products pipe lines.

LCUW

These letters stand for Low Cost per Unit of Work — the *real* yardstick in measuring wire rope economy.

Once in a while you may run across a wire rope that's lower in first cost than Bethlehem's. But with wire rope as with anything else, first cost isn't the true measure of economy. The rope with the higher price tag may be much more economical in the end — because of the longer, better service it gives. On the basis of long-range economy — *true* economy — we'll stack Bethlehem rope against the field.

Cost per Unit of Work is a flexible term, varying with different industries. It can mean the rope cost per yard of rock moved by a power shovel; the rope cost per ton of coal pulled up a hillside; or the rope cost per ton-mile in oil-country drilling. But however you use wire rope, whatever your system of records, you can be sure of this: Bethlehem wire rope means *low* Cost per Unit of Work.

That's because the Bethlehem product is a quality product all the way through — one that is conscientiously made from crown wires to core.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

***LOW COST PER UNIT OF WORK**

HOT FORGED FROM SOLID STEEL BARS!

TIME AND TOOL SAVER!

CATAWISSA

HOT FORGED STEEL

LUG NUT UNION

CAN BE APPLIED WITH EITHER A HAMMER OR WRENCH!

For all piping purposes requiring a quick opening and quick closing union, here is time and tool economy without sacrificing efficiency or dependability! Triangular shaped lug nut eliminates distortion or breaking (straight surface for hammer prevents glancing blow), gives you quick, easy application without thread crossing or sticking!

1" TO 4" SIZES WITH FULL ACME THREADS IN THE UNION NUT

STANDARD WEIGHT to 3000-lbs. O. W. G.

DOUBLE EXTRA HEAVY to 6000-lbs. O. W. G.

DISTRIBUTED BY

OIL WELL SUPPLY COMPANY

BRANCHES SERVING ALL OIL FIELDS

WRITE FOR BULLETIN 10-A

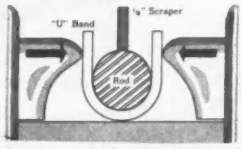
CATAWISSA VALVE & FITTINGS COMPANY CATAWISSA, PENNA.

KEEP YOUR WELLS PUMPING!

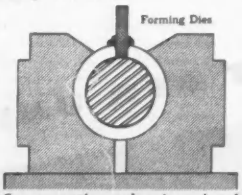
Eliminate Paraffin Accumulation the LOW COST way with...

CRALL SPIRAL SCRAPERED RODS

CRALL Spiral Paraffin Scrapers fit any sucker rod. They are NOT welded to the rod (see illustrations at right), but stay firmly in position to keep tubing free from paraffin. CRALL Spiral Paraffin Scrapers are made to fit 2" and 2½" tubing, and can be attached to your sucker rods at our fabricating plants. The *original* installation is the ONLY cost.



Cross section showing "U" band being die-formed around rod to within a fraction of an inch of scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade.

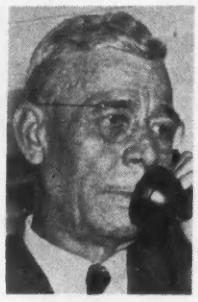
Order from your Supply Store or Write or Wire Us for full descriptive literature.

PETROLEUM SPECIALTY CO. Manufacturing and Fabricating Plants at Pampa and Levelland, Texas.

P. O. BOX 1640, PAMPA, TEXAS

MEN IN THE INDUSTRY NEWS

V. V. Bright, Houston, formerly assistant to the vice president in charge of pipe line operations, Gulf Oil Corporation, has been appointed manager of crude oil purchasing and sales. Bright has been employed by the company since 1911 and has worked at almost every job in pipe line operations. At various times he has been stationed at Beaumont, Hull, Saltillo, Paris, Fort Worth, Wichita Falls, Lufkin, and Henderson, Texas.



V. V. Bright

»

J. R. (Dick) Ellis has been elected a director and vice president of Sunray Pipe Line Company, subsidiary of Sunray Oil Corporation.

Ellis has been associated with Sunray since May 1, 1947, when he joined the company at Tulsa after more than ten years of practical pipe line experience with the Great Lakes Pipe Line Company, serving successively as gauger, clerk, chief inspector, and district engineer in various Great Lakes operating areas.

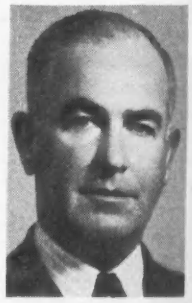
Since joining Sunray, Ellis has headed the company's program of pipe line operations. The pipe line company maintains a products pipe line from Allen to Drumright where connection is made to the Great Lakes pipe line system.

»

William J. Carthaus has been elected vice president of Deep Rock Oil Corporation, in charge of manufacturing and research, with headquarters in Tulsa. He succeeds **Wilford E. Moody,** retired.

»

Ralph P. Bolton, of the Producing Coordination department of Standard Oil Company (New Jersey), was appointed its representative for affiliates engaged in producing, refining and marketing operations in Italy.



Ralph P. Bolton

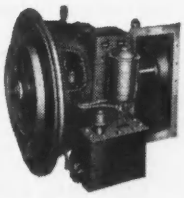
Since 1944, Bolton has headed the company's producing activities in the Eastern Hemisphere. He joined the company 27 years ago as a general field assistant for an affiliate in Roumania and within six months was promoted to field superintendent. Bolton was formerly manager of producing activities in Europe and North Africa, general manager and managing director of the Roumanian affiliate, and general manager of all company affiliates in Argentina.

»

B. P. Eastin has been appointed regional exploitation engineer for Shell Oil Company at Los Angeles. He replaces **W. C. Chonette,** who was made division manager, Los Angeles Basin division.

Softer Power for Harder Drilling

International Derrick and Equipment Company's Rambler Rig with H-40-D Hydrair Hoist shown on location.
Insert: Twin Disc Hydraulic Torque Converter (Lysholm-Smith type) mounted on H-40-D Hydrair Hoist.



On any location . . . in any formation . . . Ideco's Rambler Rigs have the power. It's soft power though, because it's transmitted through a Twin Disc Hydraulic Torque Converter which puts a hydraulic link in the hoist's power train.

This hydraulic transmission multiplies engine torque . . . eliminates engine lugging and racing . . . keeps the engine in the hi-power range.

Twin Disc's Three-stage Converters automatically adjust to the most favorable engine speed . . . instantly give maximum speed for raising empty blocks and maximum pull for coming out. Smooth transmission of power through fluid protects the engine and hoist against shock, cushions acceleration for hoisting and rotating . . . ideal characteristics for swabbing and fishing.

A pioneer in adapting torque converters to full oil field usage, Ideco has used Twin Disc Hydraulic Torque Converters for many years. For complete information on how Twin Disc Converters can smooth out your power transmission problems, write the Hydraulic Division for Bulletin 135-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

R. F. Sawyer, formerly assistant superintendent of Joe's Lake, Texas, district, American Republics Corporation, has been promoted to division superintendent of operations at Beaumont, Texas. He will supervise all drilling and production operations in the Bancroft-Hull area.

»

Phil Wagner, former district geologist for The Superior Oil Company at Shreveport, has been placed in charge of the new Rocky Mountain district office of C. H. Murphy and Company, El Dorado, Ark., with headquarters at Denver.

Roy J. Diwoky, formerly of Standard Oil Company (Indiana), has become executive assistant to the president of Pan American Petroleum Corporation.

Diwoky, who will be located at the New Orleans headquarters, will serve as a director of the corporation. Diwoky holds degrees in chemical engineering and chemistry from the University of Iowa and became associated with Standard Oil Company (Indiana) in 1935. After five years of sevice in the research department, he transferred to the manufacturing department in 1940, and rose to assistant general superintendent of the Whiting, Ind., refinery.

»

Alden S. Donnelly, of Midland, Texas was elected a vice president and a member of the board of directors of Honolulu Oil Corporation.

Alden S. Donnelly

Donnelly has been general superintendent of Honolulu's Mid-Continent division for several years, and will now be manager of operations for the division.

He has been employed as a geologist, scout, development geologist, division engineer, and general superintendent successively, and has been located in the division headquarters in Midland since he joined Honolulu in 1928.

»

Dolphe E. Simic, Bay Petroleum Company, Denver, has been promoted from chief geologist to vice president in charge of exploration for Bay and Chalmette Petroleum. Simic has been with Bay since 1946.

»

W. M. Elmer has been elected treasurer of Texas Gas Transmission Corporation. Elmer has been associated with Texas Gas since June, 1947, when he was employed as comptroller of Memphis Natural Gas Company.

»

Dr. Paul T. Walton, former chief geologist for the Pacific-Western Oil Corporation in the Rocky Mountain area, has joined the Morgan interests of Salt Lake City, Utah, and will operate as Morgan and Walton Oils, Inc.

»

Col. Robert W. McClenahan, formerly assistant chief of Staff Intelligence for **General R. L. Maxwell,** Commanding General U. S. Army Forces in the Middle East, and currently an enmploye of the Production department, Gulf Oil Corporation, received the Order of the British Empire at the British Embassy in Washington. The honor, conferred by **Sir Oliver Franks,** was in recognition of service during the period prior to the Battle of El Alamein, when McClenahan was largely responsible for obtaining intelligence information on operations in the Middle East.

R. W. McClenahan

»

Harold D. Jenkins has resigned as chief geologist for Kerr-McGee Oil Industries, Inc., Oklahoma City, and is now vice president and general manager of Decem Drilling and Production Company.

DUAL PRIME CONSTRUCTION MAKES THE BIG DIFFERENCE

Pictured is another example of the outstanding superiority and dependability of CMC Dual Prime Centrifugal Pumps. This particular pump (CMC Model 1065) is unloading barges for the Cluney Towing Company, Lake Charles, Louisiana. Pumps handling 1500 to 1600 gallons per minute at discharge pressure of 45 PSI. This is the initial installation on a new application and the excellent performance of the pump has resulted in additional orders from this firm.

CMC Dual Prime pumps have *unmatched* self-priming speed . . . the last word in simple, rugged, fool proof construction.

Write today for latest catalog. Sizes range from 1½" to 10"—3,000 to 200,000 gallons per hour.

CONSTRUCTION MACHINERY CO'S.
WATERLOO, IOWA, U.S.A.
1903 Blodgett St., Houston, Texas TELEPHONE HADLEY 3980

Look at Deep Drilling

through one of its greatest aids...

.....and see how necessary the qualities* of **Patterson-Ballagh** Casing and Drill Pipe Protectors become in a really deep drilling operation.

***Patterson-Ballagh Protectors have these outstanding qualities—**

- **Abrasion Resistance**—takes the wear instead of pipe or casing. Reduces friction and chance for twist-off.
- **Streamlined Shape**—hydraulically engineered so as not to interfere with mud circulation.
- **Firm Grip**—stay on pipe even with high bottom hole temperatures. Correctly stressed for maximum life.
- **Resilient Ends**—low stress ends for plenty of reserve elasticity to withstand tearing and cutting action.
- **Extra Length**—reduces unit loading because of greater bearing or contact area. Increases service life.

Specify

PATTERSON-BALLAGH

DIVISION OF BYRON JACKSON CO.

CASING AND DRILL PIPE PROTECTORS

PATTERSON BALLAGH · SEAL OF QUALITY · OIL FIELD SPECIALTIES

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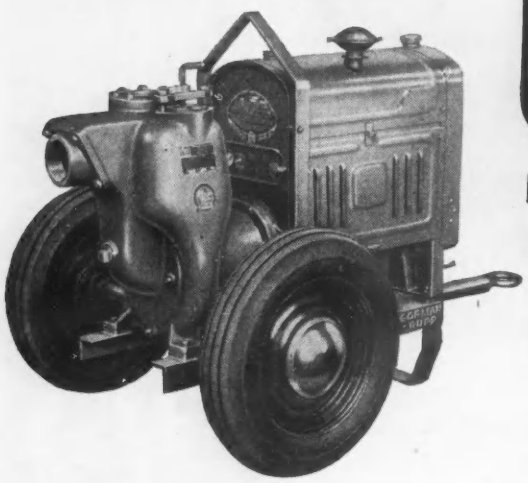
T.I.P.S.A., Santiago Del Estero 286, Buenos Aires, Argentina • A. R. Boyd, Edmonton, Alberta, Canada

Transfers and Promotions:

Arthur Drexel, production foreman for Stanolind Oil and Gas Company, transferred from East Texas Area, Longview, to North Cowden area, Odessa, Texas. **Clinton C. Harbour,** production foreman, from Nocona, Texas, to East Texas area, Longview. **E. L. Chapin,** petroleum engineer to Lubbock, Texas, district office from North Cowden area, Odessa. **W. Keith Miller,** geologist, formerly at Midland, Texas, to Fort Worth. In Stanolind's Personnel division, **James J. Johnson,** petroleum engineer, transferred to Oklahoma City from Shreveport. **G. N. Meade,** seismograph party chief, from Rock Springs, Wyo., to Ardmore, Okla. **William R. Spye,** geologist, to Oklahoma City from Tulsa. In the Texas-Louisiana Gulf Coast division, **Percy Sandel,** attorney, from Lake Charles, La., to Shreveport. **F. H. Hammons,** assistant party chief, was made party chief of a Stanolind seismograph party at Smithville, Texas. Stanolind men who have been transferred to the Calgary, Alberta, office, include **Frederick C. Beleau,** who has been made division drilling superintendent for Canadian operations. Beleau was formerly division drilling superintendent for the Rocky Mountain division, with headquarters at Casper, Wyo. Others assigned to Canadian operations are **Clarence J. Jinkins,** tool pusher, from Houston; **Truman C. Harman,** farm boss, from Wink, Texas; **Forrest G. Vergne,** field clerk, from Rangely, Colo.; and **Raymond T. Stotler, Jr.,** geologist, from Wichita, Kansas. In the Rocky Mountain division, **Jean W. Heims,** geologist, to Casper office from Tulsa. **Lynn D. Ervin,** field seismic supervisor, to Casper from Ardmore, Okla. **W. J. Moore,** formerly an assistant party chief, made party chief of Stanolind seismograph party at Rock Springs... Land department transfers in Sohio Petroleum Company include **Frank Johnson,** district chief, to Midland from Jackson, Miss., and **R. J. Bartlett,** formerly at Shreveport, to Jackson succeeding Johnson... **Carl W. Nelson,** Amarillo, Texas, to Oklahoma City as district geologist for The Pure Oil Company... **John S. Hankowsky,** petroleum engineer with Kingwood Oil Company, has moved from Jackson, Miss., to Oklahoma City, where general offices of the company have been transferred... In the Producing division of Magnolia Petroleum Company, **P. G. Wright, Jr.,** has been promoted from assistant foreman in the Brownfield Producing district to production foreman in the Kermit district. **Glen W. Barb,** petroleum engineer, Alice producing district, has been transferred to Morgan City, La. **John R. Ackenhausen,** Natural Gas department plant foremen at Mamou, La., promoted to district engineer of Wewoka Natural Gas district. Petroleum engineering personnel changes include transfer of **Vincent L. Quinlan** from Lake Charles district to Brownfield district, and **Jerry V. George** from Brownfield district to Lake Charles district. **Earl D. Cypert,** landman for Magnolia at Oklahoma City, transferred to Bismarck, N. D., where he has charge of land and lease matters in North and South Dakota. **William A. Sherman** was promoted from rotary driller in the Louisiana-Gulf division to marine drilling tools foreman. **W. H. Newman** has been made marine drilling tools supervisor of Magnolia's Louisiana-Gulf district, and will have charge of the company's offshore drilling operations. He succeeds **Goldie S. Wilkie,** who died May 16. **Howard M. Walker** has been made assistant district superintendent in the Lake Charles district. **Charles B. Swain** has advanced to assistant district superintendent of the Duncan, Okla., producing district, replacing Walker. Swain was petroleum engineer specialist in the Oklahoma City division office... **S. R. Simmons,** Shreveport, has been named assistant manager of the Southern division of Interstate Oil Pipe Line Company, Tulsa, in addition to present duties as division general superintendent. **Joe C. Rawlins,** Tulsa, transferred to Shreveport as assistant to the manager of the Southern division. **E. M. Henderson,** former assistant chief engineer of Interstate who has been on special assignment with the pipe line advisor's staff of Standard Oil Company (N. J.) for the past two years, has returned to Tulsa as chief engineer.

NEW.... Complete Line of Gorman-Rupp Heavy Duty Pumps



Challenging Any Pump, Size for Size to

PRIME AS QUICK
PRIME AS HIGH
PUMP MORE DIRTY WATER
MATCH PERFORMANCE

Gorman-Rupp Self-Priming Centrifugal Pumps have long led the field in dependability and performance. NOW! Gorman-Rupp goes further ahead with its new line of Heavy Duty Pumps.

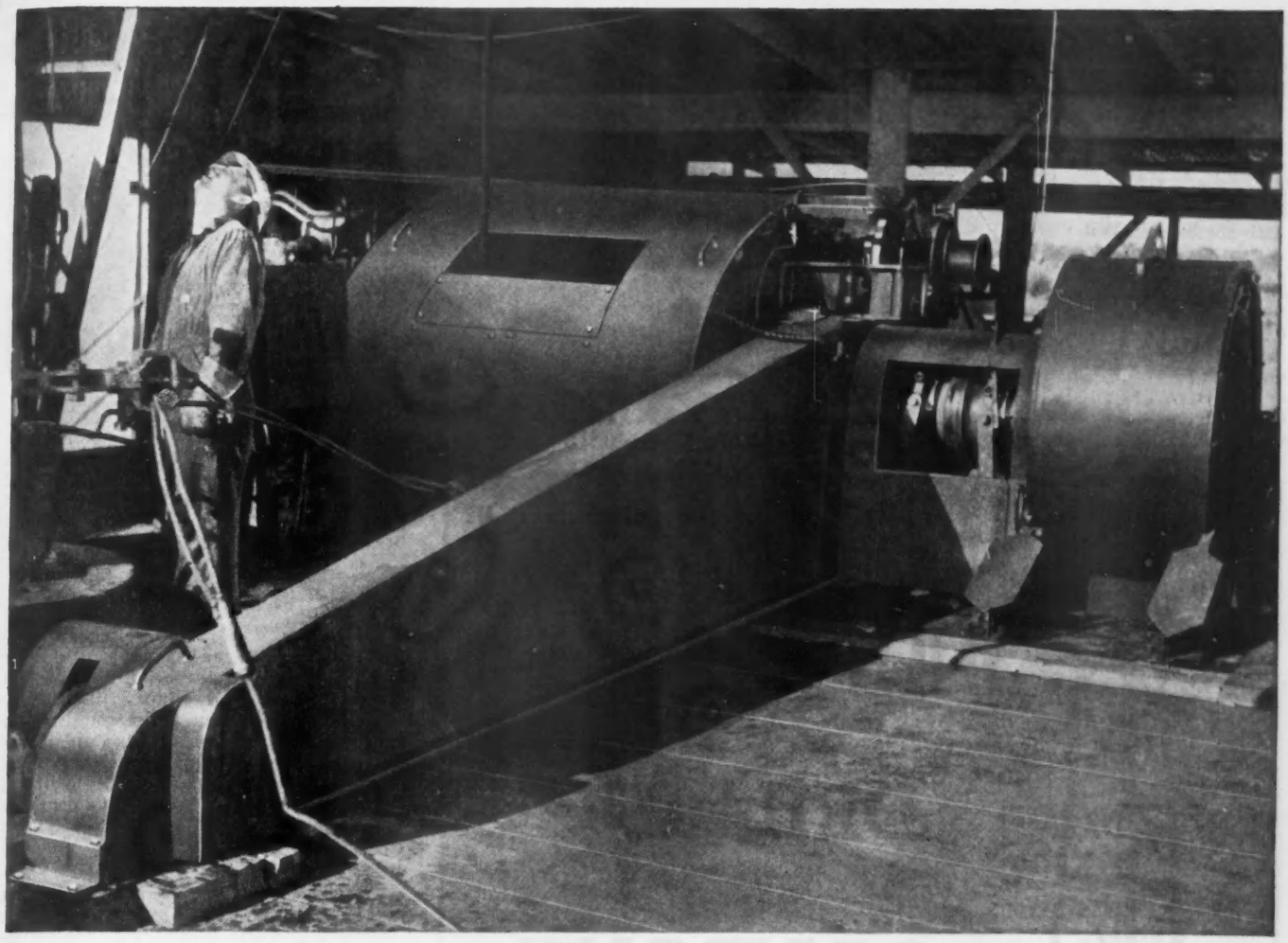
Streamlined inside, where streamlining counts, they are the quickest priming, fastest pumping, never-quit pumps available.

For instance -- the new Model 40M 4" pump primes at 20 ft. suction in just 33 seconds; 30 ft. suction in 67 seconds (sea level).

Gorman-Rupp's challenge is not idle talk. Our distributors will put a pump on the job alongside any other make, size for size. Unless our pump proves to be the best all around pump, its return will be accepted and the user paid for any installation expense incurred.

MID CONTINENT OIL FIELD REPRESENTATIVE
TOM L. TURNER
1335 MELLIE ESPERSON BLDG., HOUSTON 2, TEXAS

THE GORMAN-RUPP COMPANY



For Precision Control of Heaviest Strings

The Dynamatic Drawworks Brake provides accurate finger-tip control at driller's position of heaviest strings of pipe or casing. Completely magnetic. No brake blocks or bands. No friction; nothing to wear out.

- **Simple as a light circuit.**
- **High torque at low speeds.**
- **Operates on ordinary light plant current.**
- **Proven in all major fields, including off-shore drilling.**
- **Readily applied to all rigs—large or small. Can be installed in the field.**

Dynamatic Drawworks Brakes are available from drawworks manufacturers and their distributors. Write for illustrated literature.

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DRAWWORKS BRAKES

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DYNAMATIC DIVISION KENOSHA, WISCONSIN

EATON MANUFACTURING COMPANY, CLEVELAND, OHIO

DEATHS

Jay W. Turner, 40, vice president and credit manager of Republic Supply Company, Houston, died June 8 from injuries received in an automobile accident near Seguin, Texas. Before joining Republic in 1948, Turner was with the Sam E. Wilson Interests in Corpus Christi. He was formerly employed by Lucey Products Company, Tulsa, in the Treasury department, and served several years in the Credit department of Oil Well Supply Company at Dallas.

Jay W. Turner

David M. Rhodes, 56, president of Barbara Oil Company, Chicago, died May 31 in Evanston, Ill. Before becoming affiliated with Barbara Oil Company, he had been an independent producer in the Mid-Continent area.

»

P. M. Kerr, pioneer Oklahoma oil man, died June 1 at New Matamoras, Ohio. A native of Pennsylvania, he went to Tulsa in 1906 and engaged in the oil and real estate businesses. He moved to Ohio about five years ago.

Frank Adair Leovy, formerly vice chairman of the board and a director of Gulf Oil Corporation and chairman of the board and a director of Gulf Refining Company, died June 2, in Pittsburgh.

Frank A. Leovy

Leovy had also been president and a director of a number of subsidiary Gulf companies. He retired from all official positions with Gulf April 30, 1946.

He began his 42-year association with Gulf at Beaumont in 1904, and held many positions in the Production and Pipe Line departments of the Gulf companies in Texas and Oklahoma. In 1914 he was transferred to Pittsburgh, from where he directed production and pipe line activities of the companies in the U. S. and abroad.

»

Dr. William Van Holst Pellekaan, vice president in charge of exploration for Shell Oil Company before his retirement 11 years ago, died June 7 in Beverly Hills, Calif. Dr. Van Holst fought with the Dutch Colonial Army as an officer in the native wars of the Dutch East Indies in the early part of this century. He was pensioned by the government after being wounded, and then attended a Swiss University, where he received his doctorate in geology.

As a geologist, Dr. Van Holst served with Shell in the Far East, South America and the U. S. After his retirement he became consulting geologist for Pouder Pomeroy Company and Pearl Royalty Company.

»

Lew H. Wentz, prominent Oklahoma oil man and financier, died June 9 at Ponca City, Okla. Wentz began his oil operations in the Blackwell and Tonkawa fields of Oklahoma during their early active production, when yield was as high as 20,000 barrels of oil per day. As head of the Lew H. Wentz Company, with headquarters in Oklahoma City, he had holdings in Texas, Kansas and New Mexico, as well as Oklahoma. In recent years, he had interests in scores of lines, including a string of newspapers, machinery manufacturing, timber properties, automobile and tractor agencies, and farming. He was a Republican party leader, and participated actively in the last presidential election.

»

Cecil Floyd Stroud, 61, National Tank Company, and former sales representative for several oil field equipment firms in the Tulsa area, died May 24.

»

Harry E. Kiser, former scout for The Carter Oil Company in Tulsa, died May 16 in Dallas. He had resided in the Tulsa area since 1913.

»

Orville B. Ewing, manager of the New Orleans district office for The Youngstown Sheet and Tube Company, died May 11.

DAN L. CLARK W. M. AVERILL RUPERT COX

DAN L. CLARK

DRILLING

COMPANY

Drillers of

OIL AND GAS WELLS

POWER AND STEAM RIGS

WILSON BUILDING

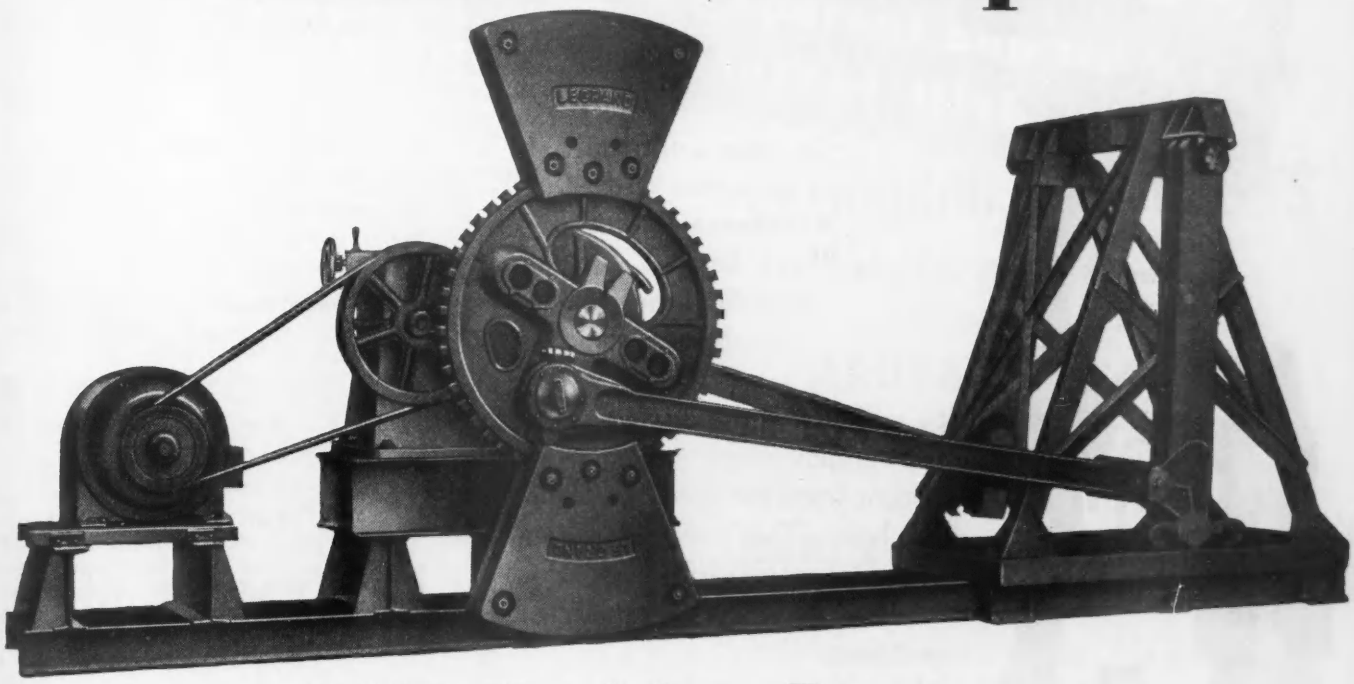
CORPUS CHRISTI, TEXAS

Telephones

Local 7746—7747 Long Distance 95

LE GRAND

Pendulum Pumpers



15/30 Pendulum Pumper

GENERAL SPECIFICATION

Max. out of balance load each pendulum	LBS.	4,900 @ 20″ Stroke 3,266 @ 30″ Stroke
Crank Strokes - -	INS.	18 & 27
Pull Line Strokes - -	INS.	20 & 30
Reduction Gear Peak Torque	LB. INS.	98,000
Reduction Gear Ratio -		30 : 1
A.P.I. Horse Power - -		13.6 at 14 S.P.M.
A.P.I. Horse Power - -		19.8 at 20 S.P.M.
Input Pulley P.C.D. - -	INS.	24½
Motor Pulley P.C.D. - -	INS.	10.53 to give 14 S.P.M.
Motor Pulley P.C.D. - -	INS.	15.74 to give 20 S.P.M.
Vee Ropes required at 14 S.P.M.		5 'C' 158 ins. long
Vee Ropes required at 20 S.P.M.		5 'C' 168 ins. long
Pulley Centres - - -	INS.	48
Counterbalance - -	CRANK	1
Max. Balance effect of counterweights	LBS.	10,100 @ 20″ Stroke 6,733 @ 30″ Stroke

LE GRAND SUTCLIFF & GELL LTD

SOUTHALL, LONDON & ROCHESTER, KENT, ENGLAND

Telephone: Southall 2211 Telegrams: Legrand, Southall Cables: Legrand, Southall Codes: A.B.C. 5th Edition

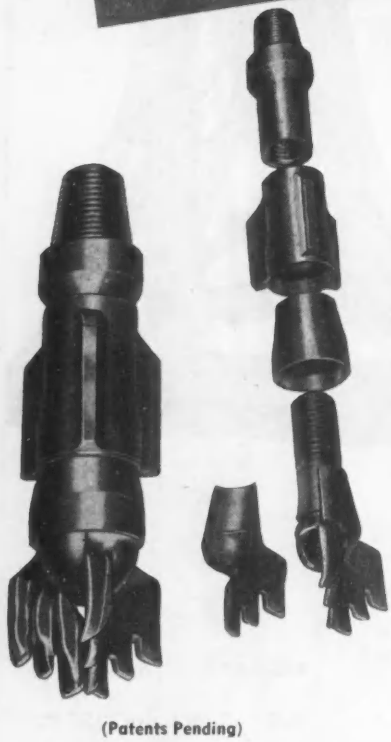
OILFIELD EQUIPMENT MANUFACTURERS & FOUNDERS

EXPLORATION DRILLERS:

HAWTHORNE *Replaceable Blade* "ROCK CUTTER" BITS

cut bit and footage costs... drill faster!

On four Continents, in every potential oil-bearing area, Hawthorne Replaceable Blade "Rock Cutter" Bits are speeding the work of exploration parties.



(Patents Pending)

It's well known that the cost of seismographic work is largely dependent upon the speed of drilling shot holes. That's why more and more exploration drillers are using "Rock Cutters" in 95% of their operations.

Discover for yourself the economy — the greater convenience — the vastly superior drilling efficiency you get with Hawthorne "Rock Cutter" Bits.

All Formation Drilling

Hawthorne "Rock Cutter" Bits drill faster in soft formations than any conventional drag bits. They also efficiently drill broken formations and 75% of all rock formations normally requiring roller bits.

"On the Bit" Drill Service

There is no bit service problem when you use Hawthorne Replaceable Blade Bits. Twelve sets of blades, weighing only 2 to 3 pounds per set, come in plainly-marked boxes that are easily carried with the drill . . . easily and quickly installed.

See GEOPHYSICAL DIRECTORY or COMPOSITE CATALOG for lists, parts, prices—or write for illustrated Catalog. Hawthorne Bits are available in a range of sizes to fit any drill.

HERB J. HAWTHORNE INC.

P. O. BOX 7299 HOUSTON 8, TEXAS

DEATHS

Dr. Walter Miller, 68, retired vice president of Continental Oil Company, died June 8 at Ponca City, Okla. He began work at the Bayonne, N. J. refinery of Tidewater Oil Company, and later became process superintendent. After serving with Pierce Refining Company and Cosden and Company, in 1922 Dr. Miller took charge of refining operations of Marland Oil Company at Ponca City. When Marland was merged with Continental in 1929, he continued as vice president in charge of manufacturing.

»

G. Pink Biter, 68, for 25 years tool pusher for Lesh & McCall, Nocona, Texas, died June 1 at Nocona.

»

Francis Marion Ginther, 70, who was associated with his sons, Noble C. and Wilbur L. Ginther of Houston in the independent oil business, died May 18 in San Antonio.

»

Rhys Edward Rees Lloyd Jr., 53, retired independent oil operator, died May 17 in Houston.

»

Daniel W. West, 56, independent oil man, died May 20 in Tulsa.

»

Edward S. (Ted) Walton, 58, in charge of excess accumulations in the flat rolled sales department of The Youngstown Sheet and Tube Company, died May 17 in Youngstown, Ohio.

»

Jonathan A. Myers, 45, engineer with Stanolind Pipe Line Company, Tulsa, died June 2. He went to Tulsa from Memphis, Tenn., where he had served with the U. S. Engineers for about 18 years. He served as an Air Force major during World War II and had been with Stanolind eight years.

»

Wallace Augustine, 72, pioneer Tulsa oil man, died May 16. A native of Ohio, where he was in the oil business, he went to Tulsa in 1913 and continued operations as an independent.

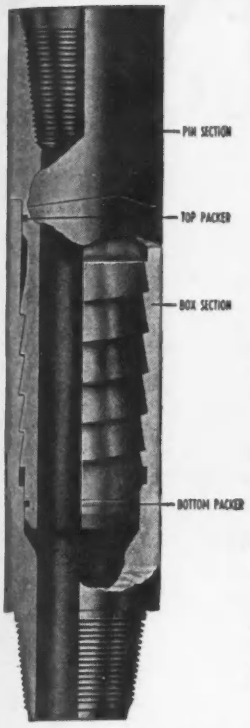
»

Lloyd G. Owen, 66, former vice president and general counsel of The Carter Oil Company, died June 15, at his home in Tulsa, Okla. After serving 24 years he retired from Carter about five years ago because of failing health. He was a native of Magnetic Springs, O., and went to Oklahoma in 1905, settling in Bartlesville. In 1915 he went to Tulsa to join his former associate at Bartlesville, **James A. Veasey,** who was general counsel for Carter. He left the oil company in 1919 to enter general practice but returned five years later to the Carter legal staff.

»

Donald Kelly, 51, independent geologist, died June 1 at Wichita Falls, Texas.

BOWEN SAFETY JOINT



For

DRILLING—FISHING
FORMATION TESTING
SETTING PACKERS

O. D. and I. D. same as regular tool joints

Will not release or back off any easier than regular tool joints.

Does not interfere with drilling, fishing or testing procedures.

Requires no special tools or attention.

Will release only by deliberate procedure of the operator.

BOWEN CO. of TEXAS, INC.

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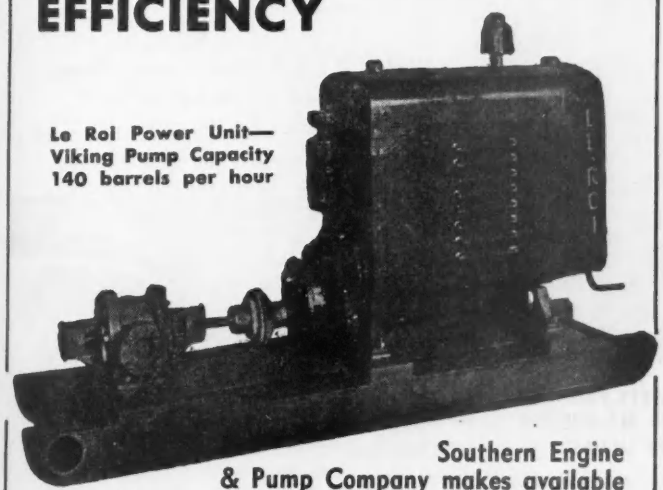
Odessa, Texas, Phone 789—Midland, Texas, Phone 1439
Oklahoma City, 6-8087—Houma, La., 6709

THE RIGHT TEAM FOR EFFICIENCY



Le Roi Power Unit—
Viking Pump Capacity
140 barrels per hour

Southern Engine & Pump Company makes available to you 40 years of "KNOW HOW" in your pumping requirements.

- Complete units and replacement parts at all branches.

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS
Houston - Dallas - Kilgore - San Antonio
Edinburg - Lafayette, La.

Fly KLM to these great

Caribbean Oil Centers

... Daily Constellation Service
from MIAMI to
ARUBA – CURACAO
CARACAS – MARACAIBO

2 flights weekly to
BARCELONA (PUERTO LA CRUZ)

The Royal Route of course! And if you have flown KLM you know this means . . . *extra* courtesies, conveniences and services! Now, Constellations give you five mile a minute speed . . . luxurious comfort. Business or pleasure . . . when you fly the Caribbean . . . fly KLM.

AIR CARGO SPACE AVAILABLE ON ALL FLIGHTS

K·L·M
ROYAL DUTCH AIRLINES
1919 30TH YEAR 1949

THE WORLD'S *FIRST* AIRLINE
TO ACHIEVE ITS 30TH ANNIVERSARY

FOR INFORMATION SEE YOUR TRAVEL AGENT OR FREIGHT BROKER or KLM Royal Dutch Airlines, 572 Fifth Ave., New York, N. Y. LU 2-4000; 308 N.E. 1st Street, Miami 3-8455. Other KLM offices in Los Angeles, San Francisco, Chicago, Washington, Boston and Montreal.

EQUIPMENT AND SERVICE SUPPLIERS' NOTES

Assistant Chief Engineer Is Named by Hughes Tool Company

F. H. Berleth has been promoted to assistant chief engineer for Hughes Tool Company, Houston. He will serve as general assistant to L. E. Garfield, chief engineer of the company.

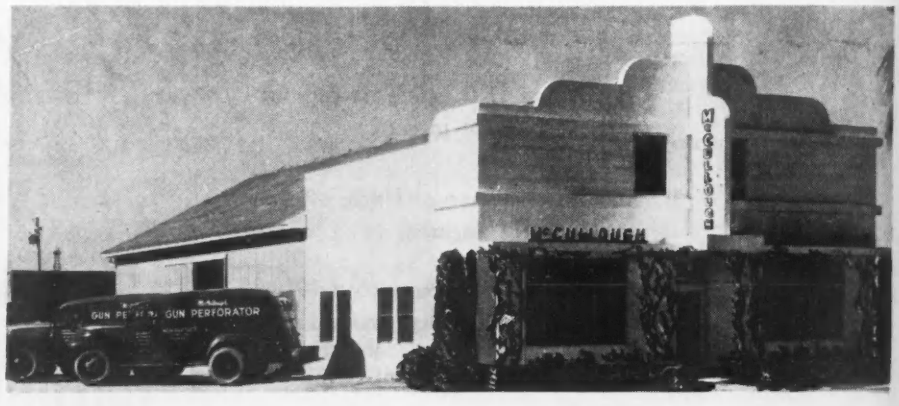
Berleth joined Hughes in 1917 as a part-time employe while attending Rice Institute. He was graduated from Rice in 1922 with a degree of B.S. in mechanical engineering.

At the time of his promotion, Berleth was manager of the Design and Drafting division of the Product Engineering department.

Oil Center Tool Announces Promotions in Engineering

Marvin R. Jones was named chief engineer and R. K. Le Rouax was appointed assistant chief engineer in promotions announced by Oil Center Tool Company, Houston.

Jones has been a member of the Oil Center Tool Company Engineering department since 1946 and during that time he has helped develop and refine many of the present O-C-T products. During the war, he served three years with the engineers and from 1939 to 1943 he was a development engineer with Cameron Iron Works. His earlier experience included two years in the rock bit engineering section of Hughes Tool Company. Jones attended Oklahoma University and is a registered professional engineer.



NEW BAKERSFIELD QUARTERS—McCullough Tool Company, Los Angeles, has opened its new building on Rosedale Highway and Mohawk Road, Bakersfield, Calif. The structure has a two-story office section and shop facilities.

Le Rouax is a graduate of Texas A. & M. College. He left A. & M. for service in the Infantry as a lieutenant and was employed by Oil Center Tool Company after his discharge in 1946. He then took a leave of absence from Oil Center and returned to A. & M. to take his degree in mechanical engineering.

Le Rouax has served as a development engineer with O-C-T and has recently returned from Rochester, Kent, England, where he helped establish material and manufacturing specifications and testing facilities in the LeGrand, Sutcliff and Gell plant.

HOMCO Establishes Service Point For South American Operations

Houston Oil Field Material Company, Inc., Houston, has announced the formation of a wholly owned subsidiary, HOMCO Service, Inc., of Delaware. Officers and directors of the subsidiary are George O'Leary, president; Robert Ewen, vice president; George E. Justice, vice president; D. U. Skinner, vice president and general manager; and J. E. Peters, secretary and treasurer.

D. U. Skinner

Homco Services, Inc., with offices in Houston and Caracas, Venezuela, will operate principally in Eastern Venezuela. Cutting and fishing, directional drilling and sidewall coring services will be available.

D. U. Skinner will be in charge of operations in Venezuela. Headquarters will be at the Punta Gorda camp, west of Maturin, State of Monagas. The camp was leased by HOMCO from the Venezuelan-Atlantic Refining Company, and will house the entire personnel of HOMCO Service, Inc.

BOOM THOSE LOADS *safer-easier* with Coffing SAFETY LOAD BINDERS

safer Because of the ratchet lever action the handle will not fly when the load is released. Shifts in loads can be adjusted by merely operating the handle. You do not need to release load to get another grab on the chain. Coffing Safety Load Binders are factory tested at 100% overload.

easier Because Coffing Safety Load Binders are light weight (Model A—11½ lbs., Model F—24 lbs.), have big capacities (3000 lbs. and 6000 lbs.) and a long lift of two feet on each model, load can be adjusted to within a fraction of an inch.

For complete information on these safe, easy-to-use load binders, write Dept. 07LB.

COFFING

SAFETY-PULL HOISTS FOR ALL PULLING AND LIFTING

Lifting pipe line, pulling rod lines, raising suction hose in drilling, bending pipe line—for these and many other lifting and pulling jobs, use a Safety-Pull Ratchet Hoist. The ¾ ton model weighs but 14 lb.—eight other models handling up to 15 tons.

COFFING HOIST CO., Danville, Illinois

Quik-Lift Electric Hoists • Hoist-Jacks • Migbty-Midget Pullers • Spur Geared Hoists • Differential Chain Hoists

Standardize on Standard

9 BIG STORES
CONVENIENTLY LOCATED

STANDARD pioneered in servicing the oil industry in the Gulf Coast. 9 big stores, completely stocked with the finest drilling and production equipment, are strategically located with respect to the active fields in this area . . .

Now comes the development of "off shore" Marine Drilling and you will find STANDARD on the ground, offering the same service that has earned the good will of operators throughout the entire Gulf Coast territory . . .

Houston has been selected as the location of our 9th branch store. Here you will find the most complete stock of drilling and production equipment and here you will receive the same co-operation and assistance in your production problems that have always characterized STANDARD service.

DISTRIBUTING THE PRODUCTS OF THESE LEADING MANUFACTURERS:

National Tube Co.
Republic Steel Corp.
Hughes Tool Co.
Reed Roller Bit Co.
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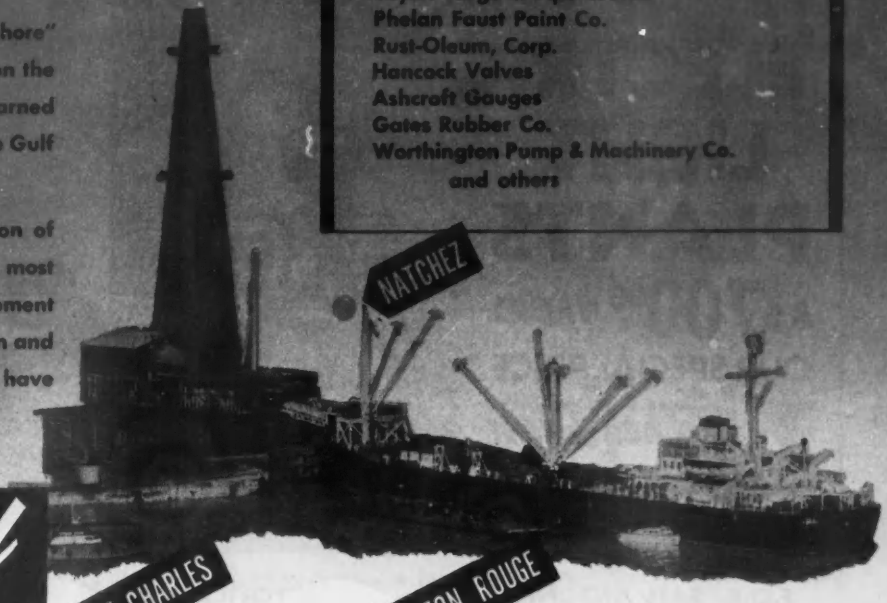
Wickwire Spencer Steel Co.
Whitlock Cordage Co.
The Lunkenheimer Co.
Edward Valve & Mfg. Co.
Hewitt Rubber Corp.
Mission Mfg. Co.
Stockham Valves & Fittings, Inc.
Web Wilson Oil Tools
Link-Belt Co.
Nordstrom Valve Co.
National Transit Pump & Machine Co.
Taylor Forge & Pipe Works
Phelan Faust Paint Co.
Rust-Oleum, Corp.
Hancock Valves
Ashcroft Gauges
Gates Rubber Co.
Worthington Pump & Machinery Co.
and others



Standard

SUPPLY AND HARDWARE COMPANY
NEW ORLEANS, LOUISIANA

Branches — Lake Charles, New Iberia, Leeville, Houma, Harvey, Baton Rouge, La.; Natchez, Miss.; Houston, Tex.
Sales Office — 1317-18 Praetorian Bldg., Dallas, Texas.

REPAIR BRANCH—Opening of the newest Cummins Sales & Sevice, Inc., factory type repair branch at 1350 Exchange Boulevard, Oklahoma City, was announced by J. E. Everroad, president. R. O. West is district service manager.

The Most Amazing Value Ever Offered!

BRAND NEW! Factory Packed!

KOHLER 1M21–1500 WATT

115 VOLT – AC MODEL

ELECTRIC LIGHT PLANTS

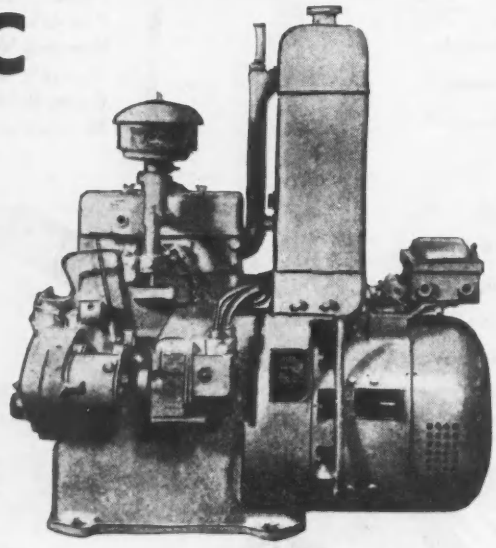
A $700.00 VALUE!

OUR SPECIAL PRICE

While They Last!

$275.00

F.O.B. SAN ANTONIO



SPECIFICATIONS

ENGINE—Four cylinder, four cycle, valve-in-head, bore 2", stroke 3", 1200 R.P.M. 4 H.P. High tension magneto ignition. Enclosed mechanical governor maintains constant voltage and regulates fuel consumption to load. Mechanical fuel pump draws fuel from supply tank.

GENERATOR—1½ KVA, 115 volt AC, single phase, 60 cycle. Built-in exciter and starting motor with large commutator. AC collector rings are a special composition that will not rust, corrode or burn.

LUBRICATION—Pressure pump forces oil to rocker arms, gears and main bearings—splash to cylinders and connecting rods.

COOLING—Water cooled, with efficient radiator and fan.

FUEL SUPPLY—10 gallon tank.

For Limited Time!

$125.00 WORTH OF OPERATING SPARE PARTS INCLUDED WITH EACH ORDER

At this price every field job and rig should be equipped!

SOUTHWEST SUPPLY CO.

1425 S. ALAMO ST. • SAN ANTONIO, TEXAS

Magnolia President Is Elected Republic National Bank Director

J. L. Latimer, president and director of Magnolia Petroleum Company, was elected a director of the Republic National Bank of Dallas.

J. L. Latimer

With the exception of a period during World War I, when he served in the Navy, Latimer has spent his entire business life with Magnolia and its affiliated companies. During his 34 years association with Magnolia, he has served in many administrative and executive capacities covering all phases of its operations. Since 1938, he has planned and directed the building of more than 2200 miles of new pipe line construction. Latimer has been president of the companies since January 1, 1946.

He is a member of the API General Committee for Division of Transportation, and the Central Committee on Pipe Line Construction. He is also a member of the Mid-Continent Oil & Gas Association.

Republic National Bank has purchased several pieces of adjoining property aggregating about 45,000 square feet of ground space for the purpose of erecting a new bank and office building. Plans for the building include provision for garage facilities within the main structure.

W. C. Norris Opens Casper Branch

W. C. Norris, Manufacturer, Inc., has opened a branch at Casper, Wyo., to serve the Rocky Mountain and Western Canada areas. The Casper store will maintain a complete stock of material manufactured by Norris for immediate shipment from that point. The branch will be under the supervision of LeRoy Mitchell.

"I'm on OUR PAYROLL, BUT— I WORK FOR YOU!"

He's Right . . . He's Your Supply Man

THIS is truer in the Oil Country than anywhere else. Stocking the right equipment at the right spot is one job. Getting that equipment to you, whenever and wherever you need it, is another and more important job. A call from you puts your Supply Man "to work for you" . . . at his company's expense . . . until the job is done.

He's a good man to have around. His base of operations is at the crossroads of activity. He knows what's going on. He knows good equipment. He has reliable first-hand information that can save you time, money, worry. It costs you nothing to put this man to work for you . . . he's ready!!

Support Your Supply Man . . . Buy All Your Needs
". . . Through Your Supply Store"

LARKIN
. . . Through Your Supply Store

LARKIN PACKER CO., INC.
ST. LOUIS, MO.

The Most Amazing Value Ever Offered!

BRAND NEW! Factory Packed!

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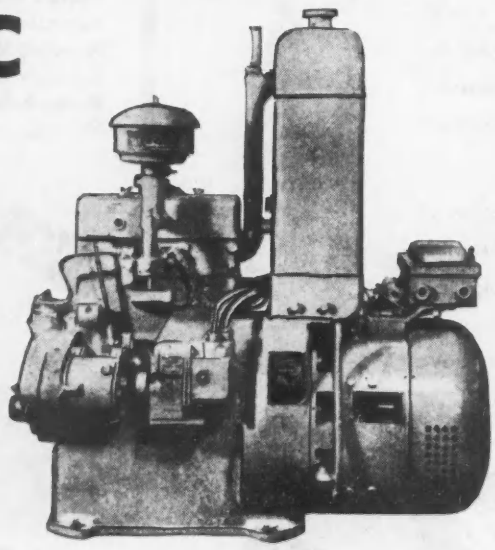

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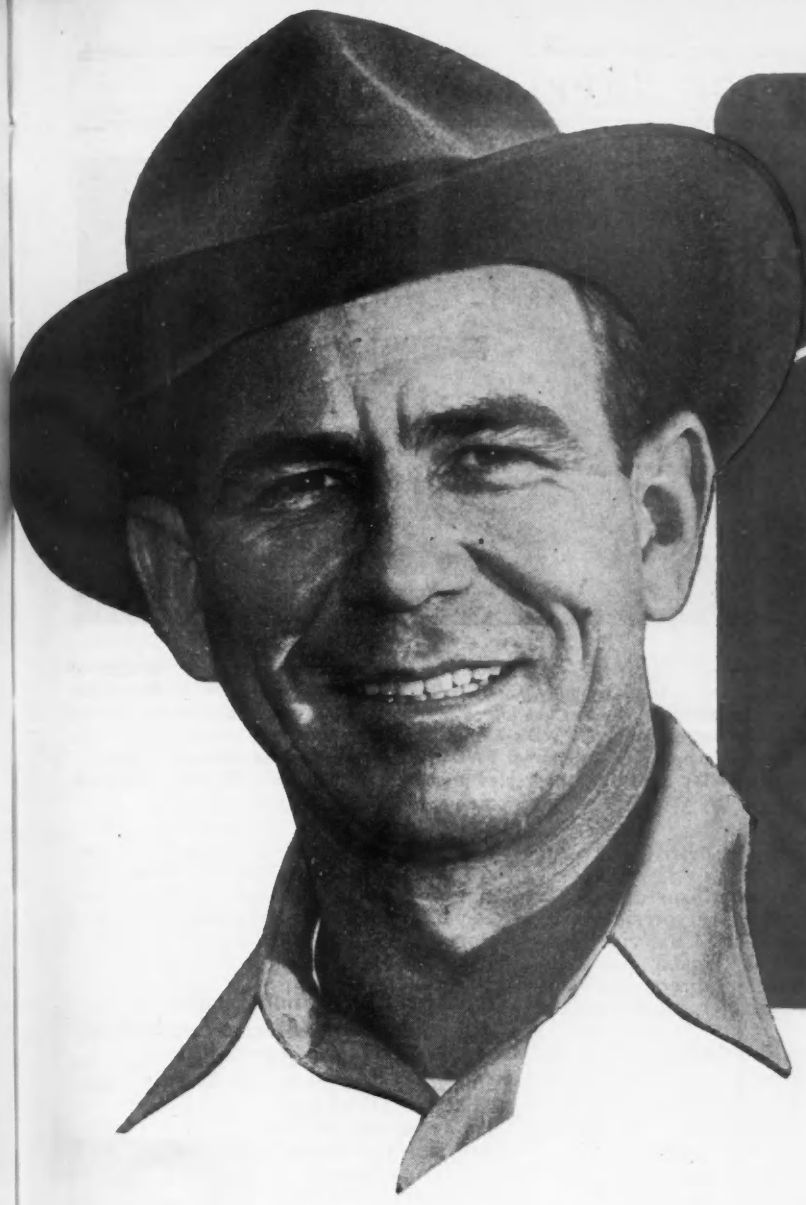

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THIS is truer in the Oil Country than anywhere else. Stocking the right equipment at the right spot is one job. Getting that equipment to you, whenever and wherever you need it, is another and more important job. A call from you puts your Supply Man "to work for you" . . . at his company's expense . . . until the job is done.

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Support Your Supply Man . . . Buy All Your Needs
". . . Through Your Supply Store"

LARKIN
. . . Through Your Supply Store

LARKIN PACKER CO., INC.
ST. LOUIS, MO.

Pittsburgh Pipe and Coupling Observes 30th Business Year

Pittsburgh Pipe and Coupling Company, Allison Park, Penn., this year observes its 30th anniversary. To mark the occasion, the company held an open house and a dinner dance at which awards were presented to five employes who had 25 or more years of service.

In 1919 the company was founded by Peter McIlroy and James Lamond, who developed a method of forging pipe couplings from a solid steel bar. The original plant of 1500 square feet has become 47,000 square feet of covered floor space, plus 273,000 square feet of open working space. Factory and office employes total 156 persons. Warehouse facilities are located at Houston.

Officers of the company, in addition to McIlroy, president, and Lamond, vice president, treasurer and general manager, are James R. McIlroy, vice president, secretary and sales manager; George Ross, superintendent; Harry W. Katzenmeyer, auditor and assistant secretary; Paul C. Borland, engineer; George E. Lourie, assistant sales manager; and Wilbert O. Harper, assistant superintendent.

FWD SALES MANAGER NAMED—R. L. Koehler, left, who has resigned as director of sales of The Four Wheel Drive Auto Company, Clintonville, Wis., congratulates M. O. Stockland, who succeeds him as sales manager. Koehler has joined in a partnership with Oscar Betow, founder of the company, and John Battes, formerly FWD's western sales zone manager, in operation of The Four Wheel Drive Pacific Company, distributor of FWD trucks for the entire state of California. Stockland was formerly FWD's advertising and sales promotion manager and Koehler's assistant.

Canadian Oil Equipment Firm Incorporated by Lucey Export

Lucey Export Corporation has announced the incorporation of Lucey Export (Canada) Ltd., to serve the Canadian oil industry. Lucey Export (Canada) Ltd. has taken over the operations of Lucey Equipment (Canada) Ltd., Drilling Supplies, Ltd., and Mineral Sales, Ltd.

Officers of the new firm are W. S. Evans, New York City, president; C. E. Paradice, New York City, vice president; and E. M. Wilkinson, managing director, J. J. Saucier, director, and H. W. Miles, sales manager, all of Calgary, Alberta.

Head office of the company is at 603 Eighth Avenue West, Calgary. Stores are located at 8645 Stadium Road, Edmonton, and at the Leduc oil field near Devon. The company plans to open a store in the Redwater field.

Johnston Corporation Expands West Texas-New Mexico Facilities

Johnston Oil Field Service Corporation, a Texas corporation with home offices in Houston, has acquired the assets and the service facilities located in Andrews, Kermit, Midland, Odessa, San Angelo and Snyder in West Texas, and Hobbs, N. M., from the M. O. Johnston Oil Field Service Corporation, a California corporation. M. O. Johnston is president of both firms.

M. O. Johnston

Both corporations heretofore were engaged in servicing oil field testing tools, gun perforation, pressure recorders, packers, adjustable flow beans, and other oil field tools in West Texas, and expansion by Johnston Oil Field Service Corporation is to eliminate overlapping of the services of both firms in the Permian Basin.

McCullough Tool Opens First Canadian Branch at Edmonton

McCullough Tool Company, Los Angeles, has opened its first Canadian service branch at 7904-104th Street, Edmonton, Alberta.

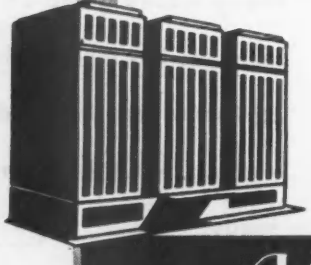
The new branch is under the management of Norman Brookes who is assisted by Verl J. (Heavy) Sanders and Stan Hendrickson, service engineers. Brookes has been with McCullough for 11½ years and previously was in charge of the Bakersfield, Calif., office.

PERSONAL
to the
1270 OIL MEN

WHO VISIT US REGULARLY . . !

We appreciate your visits . . . and would like to show you—and your friends—that our newly decorated rooms, delicious food, and Superior service are even better now! Coming back soon?

★ 600 rooms from $3.50 . . . spacious suites . . . The Southwest's most complete convention and banquet facilities. From Doorman to Manager, you'll find friendly, cooperative service at the SKIRVIN!



Skirvin HOTEL
Dan W. James, Pres.

OKLAHOMA CITY, OKLAHOMA

NEW PLANT—Web Wilson Oil Tools, Inc., has moved to a new plant at 14905 South San Pedro Street, Los Angeles. The plant has three times more covered floor space than was available at the old location, with sufficient property still available for expansion. Machinery is arranged for straight-line flow of material from the new stock to the finished product. Architects are now preparing plans for an office building which will be completed during the current year at the plant site. At present the company administrative offices continue to be located in the Wilson Building in Huntington Park, Calif.

Hedrick Engineering Will Design Plants for Petroleum Industry

Wyatt C. Hedrick, Houston, southwestern architect and engineer, has announced the formation of the Wyatt C. Hedrick Engineering Corporation. This new firm will specialize in the planning and construction of plants for the petroleum, natural gas, chemical and allied industries. Until this latest move, Hedrick's firm has engaged almost entirely in architectural engineering.

Heading the firm is G. M. McGranahan, former assistant general manager of Dow Chemical Company's Texas division, and more recently vice president and general manager of the McCarthy Chemical Company, Houston.

Other officers in the firm include H. H. Bowen, vice president; Robert H. Gaddy, secretary and Hedrick who is vice president and treasurer. Bowen has also been connected with both Dow and McCarthy Chemical Company.

The firm will maintain general offices in Houston.

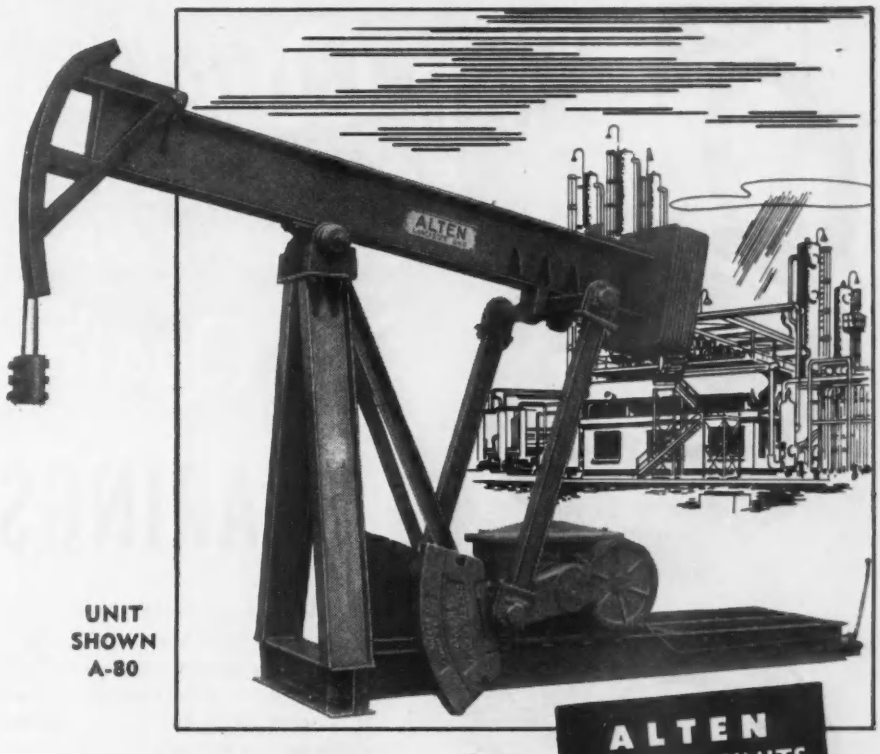
Oil Well Supply Promotes Three, Opens Victoria, Texas, Store

R. R. George has been named division office manager of Oil Well Supply Company's Gulf Coast division headquarters office at Houston. A graduate of North Texas State College in 1942, George has been a field auditor working out of the Dallas offices since joining the company in May, 1946.

M. F. Wellman, manager of the Albany, Texas, store since October, 1947, has been named manager of the Wichita Falls, Texas, store. He is succeeded by A. G. Abbott, who has been a field representative at Albany for the past six months.

Wellman was employed by "Oilwell" in December, 1945, as a storeman at Albany. Abbott became connected with Oil Well Supply Company in October, 1945, as a warehouseman at Anson, Texas.

"Oilwell" has opened a new branch store at Victoria, Texas. Donald F. Greenlaw, field representative at Alice, Texas, since June, 1948, has been named manager. Greenlaw joined the company in December, 1945, as a storeman at Alice. He also served in the Pettus, Texas, store and spent three months at Oilwell's Imperial Works at Oil City, Penn., as a student engineer. He was a city representative at San Antonio at the time he became field representative at Alice.



UNIT SHOWN A-80

ALTEN PUMPING UNITS

Built to take it-

We don't put Alten Units together like a Swiss watch.
They're not built to keep time—but keep PUMPING.
No useless, fancy frills; but all the best of alloys, gears and bearings where strain and wear get in their licks.
For work-horse efficiency, look to Alten.

Also Casing Heads, Stuffing Boxes, Stop Cocks and other production items.

A-80 FEATURES

★Rigid, all-welded steel Samson Post, Frame and Beam. Structural rating: 7,500 lbs.

★Quality Gear Reducer. Hardened alloy gears and pinions. Roller-bearing equipped. Double reduction ratio: 28.4:1. Torque rating 44,550 in. lbs.

★Adjustable stroke length: 22" to 36".

★Wrist Pin and Equalizer has double-row, spherical, self-aligning roller bearings.

ALTENS
FOUNDRY & MACHINE WORKS, INC.
Lancaster, Ohio
Established 1889
Ask for Name of Nearest Dealer

A. B. Judd Company Is Appointed Houston Tube-Turn Distributor

The A. B. Judd Supply Company of Houston has been appointed distributor of Tube-Turn welding fittings and flanges. A. B. Judd, president of the company, was president of Republic Supply Company of Houston until he resigned in 1948 to set up his own organization. He is a member of Nomads, past president of the Petroleum Equipment Suppliers Association, and a director of the Mid-Continent Oil & Gas Association.

SERVICE PLANT OPENS—This is the service plant opened by Reed Roller Bit Company in Corpus Christi, Texas. Festivities which officially opened the plant brought 2500 oil men from drilling and producing industries in the Gulf Coast area. J. M. Jones, district manager for Reed, is in charge of the new plant, and A. G. Chandler is division manager of the Corpus Christi area.

Top Quality
EQUIPMENT
CALLS FOR
Top Quality

BEARINGS

Down time is costly Drilling and other hard working oil country equipment require bearings that can resist extremely severe stress, loads and shock in round-the-clock service without wear or failure. The conception and building of special bearings for such rugged service is a basic part of our business—has been for over a third of a century. Made from high carbon or alloy steel specially heat-treated and meticulously ground, Aetna custom bearings possess plus quality that unfailingly shows up in lowest final costs.

Our service on "specials" starts with a mere idea—your mere mention of an application problem—continues through every phase of designing, engineering, laboratory testing and production to efficient operation on the job. Call on us by wire, 'phone or letter.

AETNA BALL AND ROLLER BEARING COMPANY
4600 Schubert Avenue • Telephone CAnal 7-2410 • Chicago 39, Illinois

INCREASED FACILITIES

A new plant addition, new processes and machinery, new and completely modernized engineering laboratory facilities—from these new Aetna resources will come the best bearings we have ever built, advanced anti-frictioneering service to better the oil country equipment you buy or build tomorrow.

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings

Kobe Announces District Changes, Personnel Appointments in Texas

Kobe, Inc., announced the division of the West Texas area into two sales districts. K. D. Snedeker, formerly assistant

K. D. Snedeker

Carl P. Brown

manager of the combined districts, has been made manager of the West Texas-Brownfield district. Representatives assigned to the district are Ray R. Swanke and G. T. Byer.

J. T. Lewis continues as manager for the area now designated as the West Texas-Odessa district, which includes Hobbs, N. M. Kobe representatives in Odessa are Jerry Hughes and Walter G. Gleye, and in Hobbs are W. R. Culley and H. E. Lindsay.

Carl P. Brown has been named acting district manager of the East Texas district. The change follows the resignation of J. T. Langham, formerly manager of the district. Brown was graduated from Cornell University in 1940, and entered service in 1942 as a lieutenant of Ordnance. Following his discharge in 1946, Brown was assistant superintendent of the Los Angeles plant of Arrowhead-Puritas Company, until he joined Kobe, Inc., late in 1947.

Dayton V-Belt Drive Dealer Named

Dayton Rubber Company, Dayton, O., has appointed Huge-Fayle Company, Houston, distributor for Dayton V-belt drives, with complete stocks for general industrial service.

No Twist-No Stress-No Strain

with

Mack Six-Wheelers

● That's because only Mack six-wheelers have the advantage of Mack's famed Balanced Bogie. Here's an outstanding development that means unmatched flexibility . . . mastery of the toughest terrain without stress or strain.

The exceptional flexibility of the Mack Balanced Bogie insures equal traction, even tire loading and uniform braking on all four wheels. Exclusive Mack Power Divider assures traction at all times, regardless of terrain.

Simplicity and rugged strength are typified in the functional construction of the Balanced Bogie. Maintenance requirements are reduced to a minimum. Outside of the brake system only four points on the assembly require lubrication. No place in the suspension ever needs adjustment.

For detailed information on how this and other Mack features can cut costs and increase profits on your particular job, see your nearest Mack branch or dealer.

IT'S PART OF THE LANGUAGE

Built Like a

Mack

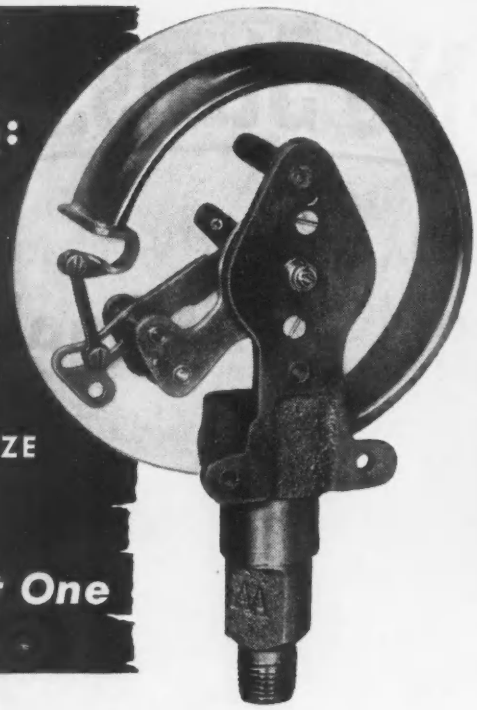
Truck

Mack Trucks, Inc., Empire State Bldg., New York 1, N. Y. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

HELICOID GAGE BOURDON TUBES:

- K-MONEL
- ALLOY STEEL
- STAINLESS STEEL
- PHOSPHOR BRONZE

Make Sure You Select The Right One

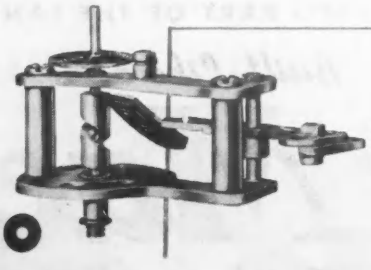


It pays to use the right kind of gage for the job. For example, a gage made with a K-Monel Bourdon tube won't corrode on certain services which ruin bronze or steel or even stainless steel Bourdon tubes in a short time.

Some such services are Hydrogen Sulfide (sour oil or gas), Hydrofluoric acid, Aluminum Chloride, Aluminum Fluoride, Ammonium Sulfate, Black Liquor, Carbon Tetrachloride, Ethyl Chloride, Oxygen, Potassium Sulfate, Sodium Fluoride, Sodium Hydroxide, and many others.

HELICOID developed the K-Monel Bourdon tube to give better and longer gage service—to eliminate trouble—to reduce cost. Helicoid K-Monel gages are guaranteed accurate to ½ of 1%. They stay accurate longer.

Of course, bronze or alloy steel or stainless steel Bourdon tubes are each best under certain conditions. It depends on the service. Use the right gage for the job. Write us if there's any doubt.



Only Helicoid Pressure Gages have the Helicoid Movement

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

TRADE MARK

EQUIPMENT and SERVICE SUPPLIERS' NOTES

HEADS DIESEL EXHIBIT—Leaving New York City on a five-month tour of the U. S. and Canada with Mack's mobile diesel engine exhibit, A. G. Crockett, right, tour manager and lecturer, receives the good wishes of A. C. Fetzer, Mack vice president and general sales manager.

Mack Trucks Diesel Exhibit Will Tour U. S. and Canada

To present its new line of diesel engines and present information on diesel performance and costs to truck operators, Mack Trucks, Inc., has launched a mobile exhibit on a five months tour through the U. S. and Canada.

Housed in the semi-trailer pulled by a Mack diesel-powered tractor are the company's three new diesel engines, the END 457, 510 and 672. Displayed are an END 672 exploded working diesel engine, and an END 457 complete as it comes off the production line, as well as a working model of the Mack Monoshift transmission and a panel with cutaway sections of the complete diesel fuel injection system.

A. G. Crockett, director of market research, is in charge of the exhibit. "Can I Use Diesels?" is the title of a talk which will be delivered by Crockett before invited audiences.

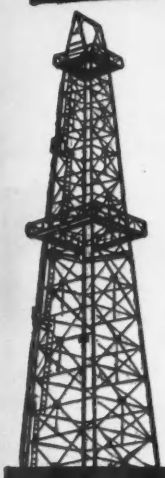
Reed Senior Representative Assigned to Northern Alberta

New senior representative for Reed Roller Bit Company in northern Alberta is Paul Steele, a former Reed representative in the Rocky Mountain area.

Paul Steele

Steele began his selling career in Oklahoma City in 1929, when he was a wire rope salesman. He later became sales representative for Reed in the Rocky Mountain district, including Rangely, Colo., and more recently was in Farmington, Colo.

THOMPSON-HAYWARD FORMALDEHYDE *Reduces* CORROSION



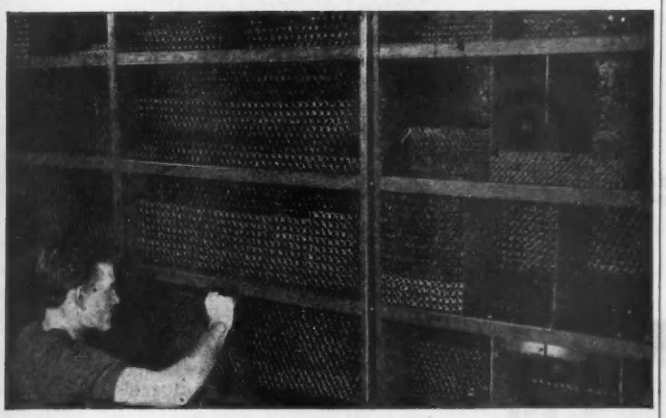
- Save on Pulling Costs
- Save on New Steel
- Save on Shutdown Time
- Low Cost
- Dependable
- Field Tested

Protect expensive and hard-to-get steel parts from hydrogen sulphide corrosion and corrosive mine and well waters, with Thompson-Hayward Formaldehyde.

Warehouse Stocks Available For Prompt Shipment

THOMPSON-HAYWARD CHEMICAL CO.

DALLAS WICHITA HOUSTON TULSA NEW ORLEANS DENVER SAN ANTONIO



Single X and Double X Lathe Cut SEAMLESS NIPPLES

- Large stocks guarantee that your supply store can furnish you promptly these precision manufactured nipples.

Plastic coating protects threads from rust and handling damage. Sizes ¼" to 6⅝" in standard lengths. Special sizes, stainless and monel to requirements.

Sold Only Through Supply Stores
Write for literature and price lists.

Longhorn MACHINE WORKS
6823 Navigation
Houston, Texas
Dallas Branch: 3901 Southwestern

You Pay No More for Pacific Economy...

When you buy Pacific Plunger Pumps you make an investment in real economy . . . an economy that is four-fold.

1. Pacific "Moloy" Liners made from Pacific's improved, exclusive molybdenum alloy; electrically cast to assure uniform quality and grain structure; produced at a cost approximately 30% higher than centrifugal-cast liners. "Moloy" Liners cost you no more.

2. Longer Life. By purchasing new Moloy Liners in minus 40 size and new Pacific Plungers in plus 40 size, and grinding liners up to the next larger size, and plungers down to the next smaller size, five runs and four regrinds may be obtained. This represents a 20 to 50% saving.

3. Interchangeable Parts. Seventy-five per cent of all Pacific Plunger Pump parts are interchangeable. This means that you save through reduced store-room stocks.

4. Quality, Material & Workmanship. Special alloys to minimize friction plus precision workmanship enable Pacific to produce metal-to-metal seal pumps that reduce fluid slippage and give higher pumping efficiency. This means economical operation on every job.

For real economy specify and buy

PACIFIC PLUNGER PUMPS!

PACIFIC *Precision Built* PUMPS

25th Anniversary

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

DW-3

National Tank Opens New Plant

National Tank Company has added 220,413 square feet of shop space to its plant capacity at Tulsa. Shown is the emulsion treater fabrication bay of the new plant. Some of the heaviest equipment installed in any plant of its type is now being used to manufacture National's line of well head-to-pipe line products and in addition it is now equipped to manufacture pressure vessels required by the refinery and chemical branches of the oil industry.

The new plant covers 5.06 acres and embodies the latest improvements in plant construction design. Some of the heavier equipment includes a 400-ton hydraulic press; steel plate rolls capable of rolling steel plate up to 2½ inches thick and 10 feet wide; two annealing furnaces, 15 x 15 x 80 feet and 7 x 7 x 40 feet. It is equipped with more than a mile of heavy crane way, one crane way alone extending for a quarter-mile. Eighty percent of light is admitted through Alsynite skylights which were first demonstrated to industry last year at the International Petroleum Exposition in Tulsa.

The new plant was designed and constructed by National Tank Company personnel, and handling methods are on the automobile assembly line principle. All material handled enters a large bay at the south end of the building where pipe and steel plate is stored. It then moves into a plate preparation bay where it is rolled into cylinders or trimmed or pressed into pressure vessel heads, then to the assembly welding bay with subassembled parts feeding from the sides into the main assembly fabrication bays.

National employs about 800 men in the Mid-Continent area and Canada through 33 branches with 500 at the Tulsa headquarters. It was founded in 1926 and its well head-to-pipe line equipment which it manufactures and distributes include stage separation units, gas dehydrators, indirect heaters, Hi Duty heaters, horizontal heaters, portable batch heaters, heater settling tanks, emulsion treaters, freewater knockouts, water disposal equipment, welded, bolted and wooden tanks, Titeline couplings, low pressure, high pressure and horizontal separators and spiral welded casing.

Petroleum Engineer Joins Bank's Oil Loan Department in Houston

The First National Bank in Houston has expanded its Oil Loan department with the addition of Grover Ellis, Jr., a petroleum engineer.

Grover Ellis, Jr.

Ellis was graduated with a B.S. degree in petroleum engineering from the University of Oklahoma, and he received his M.B.A. from the Harvard School of Business Administration.

During the war, Ellis served with the U. S. Navy and commanded a mine sweeper.

"Oilwell" Names Store Managers, District Material Supervisor

M. S. Nicklas has been named district material supervisor for the East Texas, North Louisiana and Arkansas district of Oil Well Supply Company.

Nicklas, whose headquarters will be at Greggton, Texas, has been manager of "Oilwell's" El Dorado, Ark., branch store since March, 1946. He is succeeded by Frank W. Bruner, Jr.

A veteran of 28 years with "Oilwell," Nicklas was connected with stores at Shreveport, El Dorado, and Kilgore, Texas, before becoming manager at El Dorado.

Bruner joined "Oilwell" in December, 1946. He served with stores at Greggton and Shreveport and since June, 1948, has been field representative at the latter city.

K. J. Miller has been named manager of the Edmonton, Alberta, store and is succeeded as manager of the Okotoks, Alberta, store by W. S. Palmar. O. O. Beasley and George F. Carraher have been named district representatives with headquarters at Edmonton and Calgary, respectively.

Miller has been store manager at Okotoks since November, 1947. Palmar has served as warehouseman in the Okotoks store since joining "Oilwell" in May, 1947.

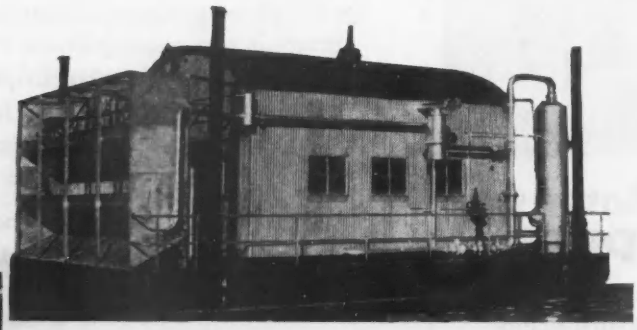
Beasley has more than 18 years service with "Oilwell" and has been manager of stores in Texas, New Mexico and Louisiana.

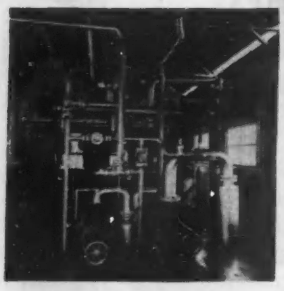
Carraher was district representative at Houston and an expert representative in "Oilwell's" Export division at New York City before taking his newest post.

ANOTHER NOTABLE "FIRST" BY Levingston

At Right — Compressor Barge being towed to location.

Below—Interior view of Barge showing compressor.





Compressor Barges for Gas Cycling or Transmission in Marine Fields

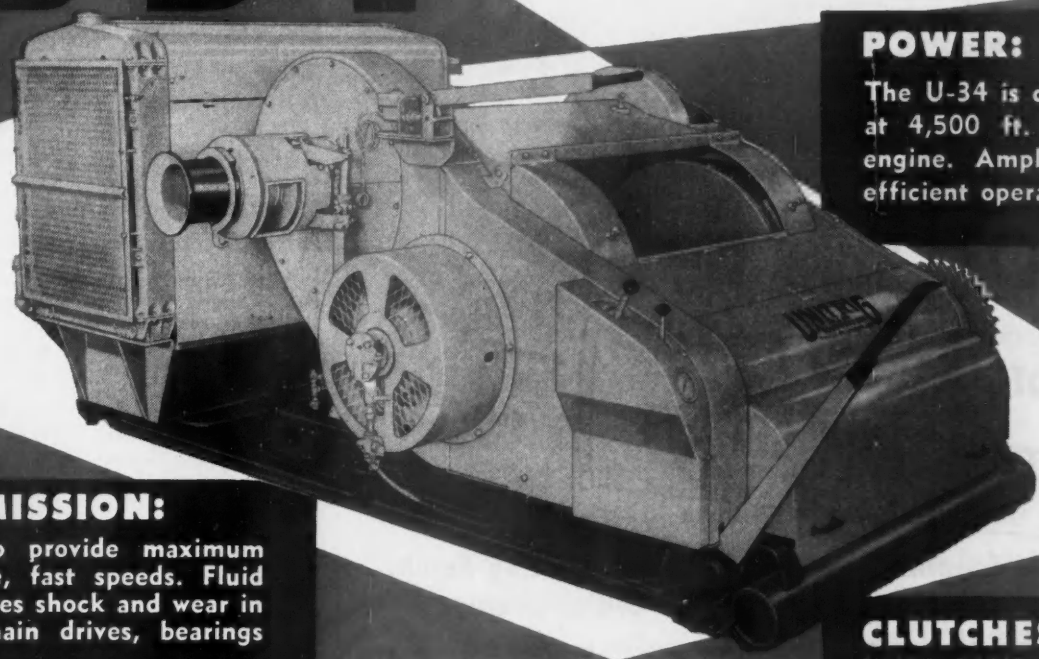
Here is another example of Levingston's leadership in the field of specialized marine equipment for the petroleum industry.

Levingston SHIPBUILDING CO.

ORANGE, TEXAS

U-34

CUT COSTS on shallow well drilling. . .



POWER:
The U-34 is conservatively rated at 4,500 ft. with a 275 H.P. engine. Ample power for fast, efficient operation and long life.

TRANSMISSION:
Designed to provide maximum pull at safe, fast speeds. Fluid coupling saves shock and wear in clutches, chain drives, bearings and line.

CLUTCHES:
UNIT RIG'S Air-O-Matic . . . time-tested under all conceivable conditions. Eliminates adjustments. Same type used on rigs of much greater capacity.

Smooth, fast, trouble-free performances are the keys to drilling in any well at minimum cost. All these features were taken into consideration when the U-34 was designed. That's why this popular, compact UNIT RIG model is being used more than ever before for shallow well drilling and servicing.

Designed for Top Performance. .

Write for Bulletin

UNIT RIG & EQUIPMENT CO.
TULSA, OKLAHOMA U.S.A.

DESIGNED FOR THE JOB. . . .

Exclusive Export Representative
MID-CONTINENT SUPPLY CO.
42 Broadway, New York City
Cable Address: MIDUNITRIG

Now! Butler Bolted Tanks are Painted by ELECTROSTATIC SPRAY!

New Scientific Technique Produces Amazing Results ... with Many Advantages for Oilfield Storage

HERE'S HOW IT WORKS...

Briefly... as the atomized paint is sprayed into an electrostatic field, the particles receive a negative charge and are attracted to the positively charged tank sheets. The attraction in the coating zone is so great that some of the paint particles change and even reverse their direction, coating more than the facing surface of the articles.

HERE'S WHAT IT DOES ...

Greater Uniformity — In electrostatic spraying, all metal surfaces attract the same amount of paint regardless of area. A uniform, long-life coating is thus assured for each sheet in Butler Bolted Tanks.

Bolt Holes and Edges Completely Coated—No "missed" spots.. no "Weak" spots where rust can start. The same amount of paint is attracted to bolt holes and edges as to the broad, flat surfaces of the metal sheets. These results are almost impossible to accomplish by hand spraying or dipping.

Tight, Long-Life Bond—All sheets in Butler Bolted Tanks are chemically cleaned, dried, coated with red oxide-zinc chromate rust inhibitive primer . . . then air dried before final painting. Such thorough cleaning and preparation assures a tight bond between finish and sheet that makes paint last longer, give better protection, costs you less.

Let Butler's experienced oilfield organization show you how you get maximum service with Butler Bolted Tanks. Call the one nearest you today.

BUTLER MANUFACTURING CO.

Kansas City, Mo.
Galesburg, Ill. Richmond, Calif. Minneapolis, Minn.

Call These Experts for Prompt Service

AMERICAN PIPE & SUPPLY CO.
Denver, and Rangely, Colo.
Casper, Wyo.
Cut Bank, Mont.

HARRY G. MILLER
El Dorado, Ark.

BUTLER

UNION TANK & SUPPLY CO.
Fort Worth, Houston, Odessa,
Alice, Tyler, Midland, Texas,
Lafayette and Homer, La.,
Great Bend, Kans.,
Tulsa, Oklahoma City, Okla.,
Hobbs, N. M., Jackson, Miss.

BOLTED TANKS • WALKWAYS • STAIRWAYS • UNIT HEATERS

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Allan Craig

Michael J. Perry

Link-Belt Company Announces Personnel Transfers, Promotions

Allan Craig, sales manager of Link-Belt Company's Southeastern division since 1945, with headquarters in Atlanta, has been transferred to Houston as general manager of the Southwestern division. A new Link-Belt plant will be opened in Houston soon.

Andrew K. Kolar

Michael J. Perry, district manager at Moline, Ill., since 1946, has been appointed sales manager, Southeastern division, with headquarters in Atlanta, to succeed Craig. Andrew K. Kolar, district sales engineer at Moline since 1947, has been made district manager.

Craig joined the company in 1923, in the Engineering department of the Philadelphia plant. Perry has been with Link-Belt since 1922, when he joined the Engineering department of the Pershing Road plant in Chicago. Kolar started work at the Pershing Road plant in 1935 as a shop apprentice.

John D. Riley has been appointed district manager at Newark, N. J., to succeed George E. Ramsden, who died April 10. The Newark office has moved to new quarters at 212 Essex Building, 31 Clinton Street.

Since 1939, Riley has been district sales engineer at the Boston office. He joined the company in 1934.

McCullough Tool Sales Engineer Assigned to Los Angeles Office

McCullough Tool Company, Los Angeles, has appointed William R. Wiley as sales engineer, operating out of the Los Angeles headquarters. Wiley, for the past eight years sales engineer for Emsco Derrick and Equipment Company, has taken the place of Lloyd A. Calhoun, who recently became general sales manager of Sweet Oil Well Equipment, Hobbs, N. M.

William R. Wiley

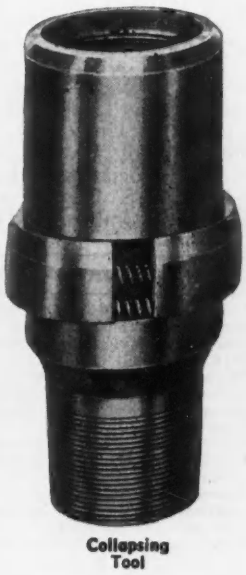
No Guessing
WHEN YOU USE THE SIGNAL CLOSING SET SHOE

With the Layne "Tubing Set" Packer, the signal closing set shoe, screen liner and packer are run in the casing with the tubing connected in the set shoe and not the Packer.

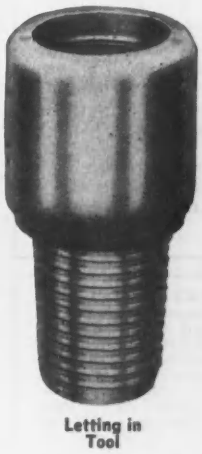
If the pump is run slowly while the valve is being closed, circulation will stop entirely when the valve is completely closed. When the "letting in" tool is released from the valve, circulation will start again.

You can make one trip into the hole do the job of two by using the Layne Tubing Set Packer.

Packer



Collapsing Tool



Letting in Tool

Tubing Set Shoe

THE LAYNE "TUBING-SET" Packer

Write for Complete Information

THE LAYNE AND BOWLER COMPANY

EXPORT:
Jeff Tucker
Room 1636
30 Rockefeller Plaza
New York, N. Y.

General Office & Factory
8000 MARKET STREET HOUSTON, TEXAS

WEST COAST:
Layne & Bowler Corp.
900 Santa Fe Ave.,
Los Angeles, Cal.

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

FOR SALE

1—Model K. Cardwell Double Drum Drawworks with rotary table drive and transmission assembly, American cathead.
2—D13,000 Caterpillar engines.
1—Type FE 12½" National Rotary Table.
1—3½" Kelly.
2—3½" Drill Collars.
Misc. 3½" Drill pipe slips, Kelly bushings, and drill pipe subs, all in first class condition located our McPherson, Kansas yard.

VEEDER SUPPLY & DEVELOPMENT COMPANY
Cherryvale, Kansas

■ ROTARY equipment almost new, only used few days, 1800' PK rods, Drill collar 30'x4¼" with 3½" box, King water swivel 1¼", PK slips, hoist plugs, overshot. Complete outfit $4500 or will divide. We handle new and used spudders, rotaries, core drills, pipe, tools, cable. Fishing tools and equipment rented. Pressey & Son, Pueblo, Colo.

■ FOR SALE: No. 2 National Drilling Machines, complete with tools and motor. Paul Enssiin, Box 68, London, Ky.

FOR SALE

ONE No. 10 UNIT RIG DRAWWORKS with Two D13000 Caterpillar Diesel Engines Compounded. Equipment in good shape. KIOWA DRILLING COMPANY, INC., 717 Union National Bank Building, Wichita 2, Kansas. Phone 3-8013.

It's New... Check It!

PIPE GRINDING MACHINE designed and built to give pipe line contractors maximum service in polishing the bevel on plain end pipe in preparation for welding. The machine can be placed on pipe easily and quickly, and will clean the bevel on 24-inch pipe in 15 seconds, whereas a man with file would have to work at least 15 minutes. The grinder is constructed for durability, light weight, effectiveness and economy. Electrically driven, it may be operated from electric welding machines on the line.

The Machine was perfected, and now being manufactured by

WICHITA TOOL REPAIR CO.
of Wichita Falls, Texas
Under license from O. R. Hall, inventor

FOR SALE

■ Oil Leases in Western Canada for sale or development. Address: Box 31-W, c/o World Oil, Houston, Texas.

WANTED TO BUY

■ Will buy producing or non-producing Minerals or fee lands. Write full particulars: H. A. Hawthorne, Thibodaux, La.

NOTICES

■ "UTAH'S FIRST DISCOVERY"—1600 acre lease beginning 1½ miles north east. All sec. 12, all 1—E½ 11. NWNW13 5S R22E. D. Miller, Box 1581, Station D, Los Angeles 7, California.

■ Petroleum consultant services available for Mississippi, Arkansas, Tennessee. I would like to handle your buying, blocking, drilling. Lease and royalty buying on order only. Write Lee Raines, 1604 Vance, Memphis, Tennessee.

WANT DEVELOPMENT DEALS

Prefer proven or semi-proven or farmouts. Might consider wildcats on good geological information. Have million dollars to invest this year and more on any production deal in Mid-Continent.

HARRY HINES
609-11 Gulf States Bldg., Dallas, Texas

HELP WANTED

WANTED: In Indiana, Michigan, Illinois, and Kentucky, sales commission representatives to sell and service well established line of tong-pull back springs, drill pipe wipers and protectors, shale or cement baskets, scratchers and centralizers. Applicants must have previous drilling or engineering experience, and also a knowledge of corrosion, cementing and pipe protection problems in area applying for

Weatherford Oil Tool Company
Personnel Department
P. O. Box 303, Weatherford, Texas

ASSISTANT SALES MANAGER: Large midwest independent needs young aggressive man with good experience in petroleum sales for position of assistant sales manager. Expanding operations require high type executive for this permanent position. In replying, give full details including age, education, and salary required. Replies confidential. Address: Box 24W, c/o World Oil, Houston, Texas.

WANTED - Land Man thoroughly experienced, by well-known independent oil company. Liberal salary with opportunity for rapid advancement. Give record of experience. Answers held confidential. Box 26W, c/o World Oil, Houston, Texas.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

PROTO Professional Quality TOOLS
REG. U.S. PAT. OFF. LOS ANGELES MADE IN U.S.A.

NEW TRADE MARK—Completion of a new trade mark design featuring the brand name, "Proto," has been announced by Plomb Tool Company, Los Angeles. "Proto" was adopted early in 1948 and the new over-all design was developed as a means of speeding recognition and remembrance of the trade mark by hand tool users. The design employs a special type of lettering, shows the young lady used in the company's old design, and includes the phrase, "Professional Quality." It will be used for catalog and other literature, as well as for decals, signs, display boards and other point-of-sale materials.

Nordstrom Special Representative Is Appointed by Rockwell Company

Roy R. Bush has been appointed special representative for Nordstrom Valve division, Rockwell Manufacturing Company. In addition to aiding the regular sales force on major projects, Bush will work with customer personnel on methods and routines of maintaining and servicing Rockwell products.

Roy R. Bush

Bush joined the company's sales staff in July, 1934, and has been assigned to the Tulsa district office since. He was previously employed by the Texas Pipe Line Company in West Texas, and also worked on drilling rigs in the Mid-Continent area as a tool dresser and roughneck. He attended Oklahoma University. Bush was past president of Natural Gasoline Supply Men's Association and a member of the API, Tulsa Engineers Club and the Technical Club of Oklahoma.

SITUATIONS WANTED

■ Position wanted with independent oil company as office engineer or oil field map compiler. Have over twenty years experience with major oil company as Party Chief, Field Engineer and Map Abstracter in Gulf Coast region of Texas and Louisiana. Best of references. Address: Box 29-W, c/o World Oil, Houston, Texas.

■ ACCOUNTANT, oil producing and drilling accounting experience, two years as Internal Revenue Agent, B.B.A., C.P.A., age 31, desires position as head accountant tax man office manager for independent operator or drilling contractor. Prefer Houston area. Box 30-W, c/o World Oil, Houston, Texas.

LEASES, DRILLING, ACREAGE, ETC.

■ Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving in fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.

■ For Leases, Minerals and Royalties, West Texas, Write Onas Ferguson, 1411 West Tennessee, Midland, Texas.

New Books and Maps

Oil in the Southwest

The economic foundations of six Southwestern states are so dependent upon the production of petroleum, through salaries, royalties, and taxes, that each would have to contend with inestimable problems and would face a struggle for survival should the oil sands cease to flow.

This is the picture drawn by Carl Coke Rister in a book entitled "Oil! Titan of the Southwest." However, the author does not predict a "drying up" and an end to oil production in the Southwest, and describes extensive prospecting now going on in search of new fields in Kansas, Arkansas, Louisiana, Oklahoma, Texas and New Mexico.

From information collected on research trips during the course of three years, he has written a comprehensive account of the search for and development of oil resources in the Southwest: the historic Lucas well at Spindletop, Texas, in 1901; strikes at Glenn Pool, Mexia, Oklahoma City, and East Texas; the period when oil went begging at 3 cents a barrel in Beaumont while water was scarce at 5 cents a cup; and the all-important part which oil played in World Wars I and II.

University of Oklahoma Press, University of Oklahoma, Norman, Okla., $5.

Yearbook for 1949

Completion details on new oil and gas discoveries in 22 states during 1948 are given in the annual Yearbook for 1949, compiled by the staff of Ira Rinehart's Oil Reports.

Contained in the two volumes are a financial review of the industry for 1948, yearly record of drilling and production in each state for all previous years and individual summaries of each new field. Oil field maps of 22 states are presented as well as seven regional maps, one U. S. map and 70 individual field maps.

Ten papers on topics from theoretical geology to factual matters of allocation, which were presented to the oil industry during 1948, are included.

Rinehart Oil News Company, P. O. Box 1208, Dallas, $10.

Safety Posters

The 1949 Directory of Occupational Safety Posters, prepared by the National Safety Council, is a 72-page book containing 744 illustrations of 2-, 3-, and 4-color posters, classified under 15 sections. A convenient index quickly locates posters on specific accident hazards. Posters range in size from 8½ by 11½ inches to 10 by 12 feet. National Safety Council, 20 North Wacker Drive, Chicago 6, 50 cents.

Ohio Oil and Gas Fields

In a new map, "Oil and Gas Fields of Ohio," 488 fields are named and located, and the producing sand indicated. A generalized geologic column of the rocks of Ohio is shown, with both formation names and drillers' terms listed. Outcrop line of the Berea sandstone is also indicated.

The colored map, by Robert L. Alkire, Columbus, is 40 by 52 inches, scale one inch equals six miles.

Geological Survey of Ohio, Orton Hall, Ohio State University, Columbus 10, $1.

Rocky Mountain Operations

More than 170 pages of maps, statistical data, geological and geophysical information of oil activities in Wyoming, Montana, Colorado, Utah, and adjoining Rocky Mountain states, are contained in the Nineteenth Annual Resume of Rocky Mountain Oil and Gas Operations.

Well completions for the year 1948 plus production statistics for each Rocky Mountain field are listed in the review. There is discussion of new discoveries during the year, plus data on leasing activities throughout the region.

Petroleum Information, Inc., National Supply Building, Casper, Wyo., and Continental Oil Building, Denver 2, $10.

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Not only is it easy on rods and surface equipment because of its small capacity, but also the Stripwell pump usually increases production if it is run longer hours (than the well had previously been pumping) at a speed and stroke which will permit the fluid to be pumped out at the same rate as it flows into the well bore.

Sturdily built, the pump has an outer jacket which encloses the working parts and takes the strain when the pump is pulled. This pull tube also agitates fluid above the hold-down reducing any tendency to sand up.

Other features:

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The Stripwell is **the** pump for stripper wells.

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SQUEAKS from the BULLWHEEL

Pot Luck

Two gamblers were convalescing in a hospital endowed by a very strict religious denomination known for its opposition to gambling in any form. Thinking they had better keep in practice during their illness, they repeatedly asked for playing cards and were refused. Finally they asked the superintendent if they might have 52 "case report cards." This request was granted and the gamblers set about devising their own game of poker; instead of going by suits and numbers, they bet on the information on the cards to determine their value. After dealing, drawing and betting, one of the gamblers said, "I'll check, what have you got?"

"Two pair—a pair of adenoids and a pair of tonsils. What are you holding?"

"Four enemas," replied the first gambler.

"You win. Take the pot."

Occupational Hazard

"Don't you wish you were a barefoot boy again?"

"Not me, lady. I work on a turkey farm."

Childhood Memories

A prominent bishop sat in a box in the opera house awaiting the curtain and watching the fair ladies in low-cut evening gowns being ushered to their seats. After looking around the house with opera glasses, one of the ladies in the party said:

"Honestly, bishop, did you ever see anything like it in your life?"

"Never," gravely replied the bishop. "Never since I was weaned."

Know-How

The strong man at the fair had squeezed the juice out of a lemon. Holding it up before the crowd he shouted, "I'll give $5 to anyone who can squeeze another drop of juice out of this lemon!"

Up stepped a little man. He gripped the lemon, and to the surprise of the crowd, squeezed out several drops.

"It's easy," he murmured. "I'm a tax collector."

Indoor Sport

A damsel who hailed from Madrid
Was naughty in all that she did.
She favored strip poker
And played till it broke her,
Which made her a popular kid.

Vulnerable Point

In a crowded train, a salesman sat down beside a young woman who fought a desperate but losing battle to keep her skimpy skirt from creeping over her knees. After another futile yank, she looked up to meet the gaze of her traveling companion. "Don't stretch your calico, sister," he said, "my weakness is liquor."

Sunny Side Up

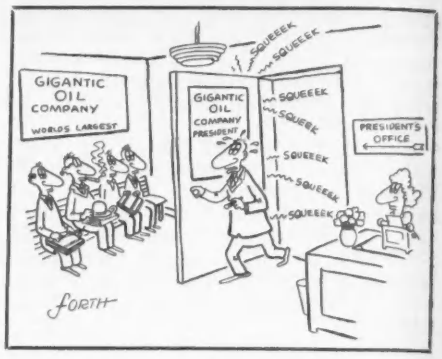
Going into a lingerie shop to buy a brassiere for his wife, the customer found it was necessary to know the size wanted. The friendly clerk tried to help him out of his difficulty.

"Are they about the size of grapefruit?"

"No, smaller," replied the customer.

"Then, how about eggs?"

"Yeah. Fried."



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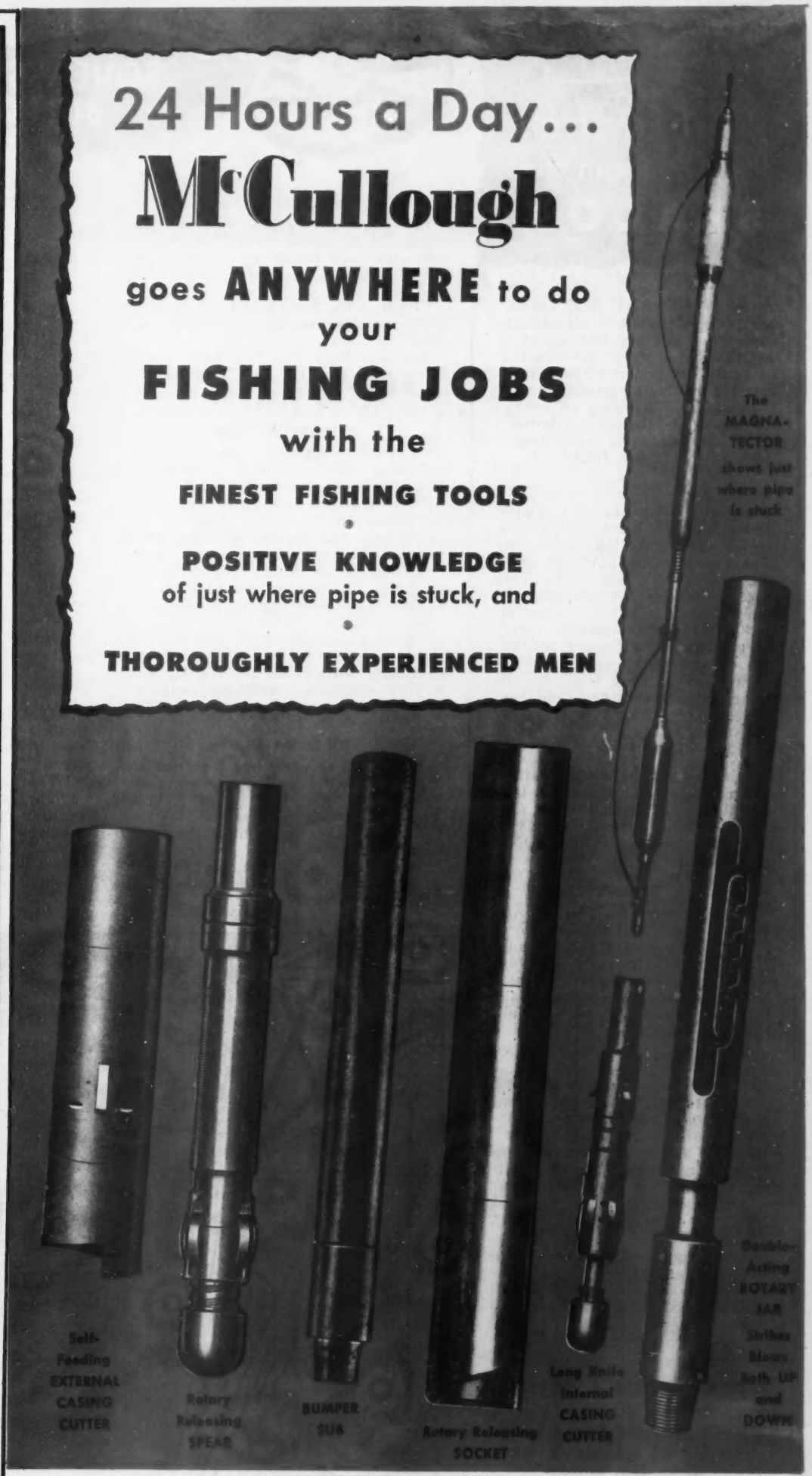
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Double-Acting ROTARY JAR Strikes Blows Both UP and DOWN

Flashes from the BEACON

A NEW BS&B oil field product always spells news to oil and gas men. This time, pipeline operators get the nod with the introduction of a newly engineered Fuel Vaporizer for gas-fueled pipeline pumping engines. The story of its development and the job it is destined to do will appear in your August copy of the BS&B BEACON.

* * *

Oklahoma folks are still talking about Chauncey Black's salty, comprehensive tale of Oklahoma City that ran in the BEACON early this year. Fort Worth worthies are hereby notified that Chauncey's typewriter is cocked in their direction. The lusty origins and eventful growth of this Texas town that has resisted all efforts to make it a carbon-copy "big city" will be recounted. Our artists will add their impressions to Fort Worth's colorful story.

* * *

"Let's all be happy and live within our means, even if we have to borrow the money to do it with," says "Pop" Kenyon in his OBSERVATIONS, one of the BEACON'S most popular regular features.

* * *

"Square Dancing Isn't Square Any More," might well be the title of Ray Winningham's calico-and-blue-jeans article on a whirling, stomping American pastime which has come back into its own to the tune of scraping fiddles and full-throated laughter.

* * *

As rare and refreshing as an August breeze and as bright as your wife's quilt pieces are the paragraphs of "Paging the Ladies." Informal and informative, Alberta Wilson Constant's monthly department is a "standard" with our feminine readers.

* * *

Not getting the BEACON? You can—without charge . . . A request on your company letterhead will start the BS&B BEACON coming your way.

Write to:

BLACK, SIVALLS & BRYSON, INC.
Industrial and Public Relations Division
720 Delaware
Kansas City, Missouri

SQUEAKS from the BULLWHEEL

First Things First

A well-dressed woman was walking down a very windy street, holding her hat with both hands. A fellow on the corner, getting an eyeful, stepped up and said:

"Lady, why don't you hold your hat with one hand and your skirt with the other?"

Said the lady, "Sir, I'll have you to understand that this is a new hat and what you're looking at is 37 years old."

Stormy Weather

A drunk staggered home and made his way subconsciously through the house, winding up in the stall shower of his bathroom. As he groped about, he turned on the water, deluging himself plenty and making a racket which brought the Little Woman on the scene.

Taking in the details, she called him all kinds of soandso, winding up with a none too flattering estimate of his past, present and future.

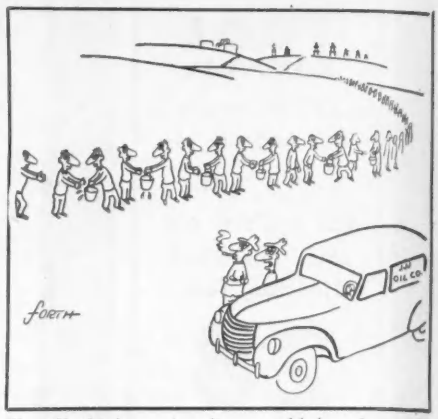
"That's right, honey," admitted the shuddering sot. "I'm everything you said—and worse. But let me in, won't you? It's raining something awful out here."

All in the Family

Pablo had recently been married and a friend asked how things were going. Pablo said, "O.K., I guess, but I theenk maybe I married my seester."

"What makes you think that?" the friend asked.

Pablo replied, "Well, alla time she geegle and say to me, 'Oh, brother!' "



"I still think a pipe line would be cheaper!"

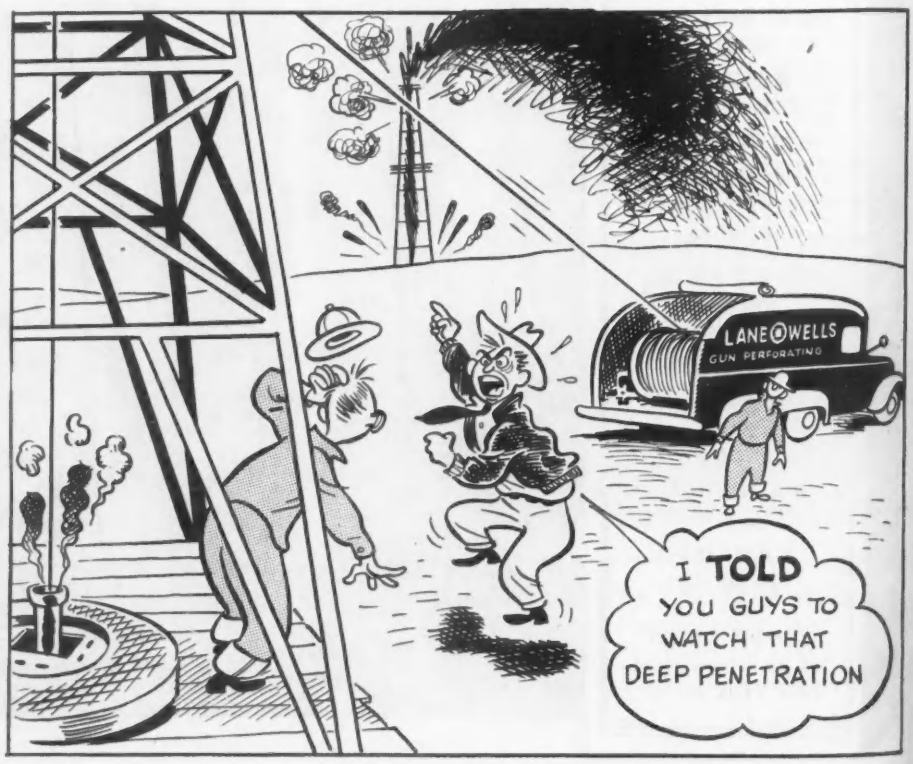
Strictly Amateur

Looking over an assortment of perfumes such as "Take Me," "My Sin," and "Heavenly Night," the young girl inquired of the clerk: "Haven't you anything for a beginner?"

Minor Operation

"What a silly thing to do!" said the doctor's wife as she looked at the book from which her husband had torn some pages.

"What's wrong, dear?" he asked.

"Why, you've torn all the pages from the back part of this book," she replied somewhat angrily.

"Ah," he said, "can't you let a fellow have a little fun? I haven't removed an appendix in a long time."